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FRESHWATER SCALED HETEROTROPHIC PROTISTANS FROM FOUR GULF STATES, INCLUDING DESCRIPTIONS OF TWO NEW SPECIES

Daniel E. Wujek
Department of Biology
Central Michigan University
Mt. Pleasant, MI 48859

ABSTRACT

A total of 22 scale-bearing protistans was observed from 27 freshwater sites in the Gulf Coast States of Alabama, Mississippi, Louisiana and eastern Texas. Included are the descriptions of two new heliozoan species: *Acanthocystis dürrschmidtidae* and *Pterocystis mikrjukovii.* While 19 of the taxa have been reported from other world wide geographic locations, 16 are new records for the United States.

INTRODUCTION

The role protozoa play in aquatic and terrestrial ecosystems has been well established. Only recently have we begun to understand the biogeography of flagellated protozoa (see Tong *et al.*, 1997 and literature therein). The studies cited in this paper, based on both light microscopy (LM) and scanning and transmission electron microscopy (EM), included Arctic, equatorial, and northern and southern temperate sites.

While the taxonomy of silica-scale bearing algae of the golden-brown algae (Chrysophyceae and Synurophyceae) has been affirmed on the structure of siliceous scales as determined with the electron microscope (Takahashi, 1978; Asmund & Kristiansen, 1986; Siver, 1991), "the use of similar criteria in scale-bearing protozoa has been slow to develop" (Nicholls, 1983a). Petersen and Hansen (1960) were the first to describe new species of heliozoa based on electron microscopy of scales. Since then, the literature has been sporadic. Only the studies of Dürrschmidt in Chile, New Zealand and Sri Lanka (1985, 1987a,b), Nicholls and co-workers in Canada (Nicholls, 1983a,b; Nicholls & Lynn, 1984; Nicholls & Dürrschmidt, 1985), Croome and co-workers in Australia (Croome, 1986, 1987a,b,c; Croome *et al.*, 1987), Siemensma and Roijackers in The Netherlands (Siemensma, 1981; Siemensma & Roijackers, 1988a,b; Roijackers & Siemensma, 1988) and Mikrjukov in Russia (Mikrjukov, 1993a,b, 1994a,b,c, 1995, 1996a,b, 1999, 2000a,b) have demonstrated that scale structure in heliozoa possessing siliceous scales is likely the single most reliable taxonomic criterion.· Previously much of the taxonomy was based on light microscopy of variable cell features (e.g., color, size, vacuolation, etc.) or of scales, the structure of which cannot be determined properly by LM.

An examination of freshwater phytoplankton samples from across the Gulf Coast states of Louisiana, Alabama, Mississippi, and eastern Texas for silica-scaled chrysophytes has shown a rich diverse flora (Wee *et al.*, 1993; Wujek & Menapace, 1998; Wujek, 1999; Wujek *et al.*, 2003; Wujek, unpublished). These samples also contained heliozoans and other scaled protistans as part of their plankton. The purpose of this paper is to give a taxonomic account of scale-bearing protistan species found in four Gulf Coast states with descriptions of two new species.

MATERIALS AND METHODS

Lugol fixed samples from a wide variety of freshwater habitats in four Gulf Coast states (Table 1) were examined using transmission and scanning electron microscopy as previously described (Wujek & Menapace, 1998; Wujek, 1999; Wujek *et al.*, 2002). LM utilized a Zeiss Photoscope; as iodine was used as a preservative, no additional stains were employed. All measurements were based on EM. A minimum of three cells were used in determining cell and scale sizes.

OBSERVATIONS AND DISCUSSION

Twenty-two species and subspecies of *Acanthocystis*, *Choanocystis*, *Cochliopodium*, *Cyathobodo*, *Lepidotrachelophyllum*, *Pinaciophora*, *Polyplacocystis*, *Pterocystis*, *Raphidiophrys* and *Raphidocystis* were observed from various Gulf Coast freshwater sites; included is the description of two new species of *Acanthocystis* and *Pterocystis* (Table 2, Figs. 1-22). The heliozoan classification that follows is according to Page and Siemensma (1991).

Heterotrophic Flagellate

Cyathobodo crucifera Swale & Belcher Fig. 1.

The only previous report is from England (Swale & Belcher 1975), although scales were illustrated in a figure reporting the prymnesiophyte alga *Chrysochromulina parvula* Lackey for the United States (Thompson & Halicki, 1965). *Cyathobodo* is placed within the order Pseudodendromonadida (Hibberd, 1985), together with the genus *Pseudodendromonas*, a genus first reported for the U.S. from Mississippi (Wujek, 1999). The Pseudodendromonadida are members of the class Cyathobodonea within the phylum Opalozoa (Cavalier-Smith, 1993). Karpov (2000) recently recognized still another order, the Bicosoecida, into which he placed *Cyathobodo* and *Pseudodendromonas* into his newly recognized family Pseudodendromonadidae. This species was observed in both Alabama and Mississippi collections (Table 2).

Protistans

Ciliophora

Lepidotrachelophyllum fornicus Nicholls & Lynn Fig. 2.

Lepidotrachelophyllum fornicus is considered to be a haptorid Ciliophora (Patterson & Hedley, 1992), a group of predatory ciliates which makes use of extrudosomes, a structure that can be extruded (e.g., to catch or kill prey, or for protection) around the mouth region. Only isolated scales were observed in the TEM preparations (Fig. 2). Nicholls and Lynn (1984) have shown the scales to be organic and not composed of silica or calcium, the elements that comprise scales within the Chrysophyta (*sensu lato*).

Since its original description from Ontario, Canada (Nicholls & Lynn, 1984), *Lepidotrachelophyllum fornicus* has been reported from the Carolinas (Wujek *et al.*, 1999) and Florida (Wujek, 2002). I observed it from only one sampling site (Table 2).

Rhizopod Amoeba

Cochliopodium bilimbosum Auerbach Fig. 3.

Species of the genus *Cochliopodium* are rhizopod amoeba with one or more pseudopodia and without a firm shell (Patterson & Hedley, 1992). They have been reported, frequently in large numbers, from a broad range of habitats ranging from marine and fresh waters, activated sludge plants, percolating filters, small streams and ponds, sphagnum swamps, soil, fecal material and even from cooling towers (see Wujek, 2002 and literature therein). It is perhaps surprising, therefore, to find that these organisms have not formed the subject of any major investigation.

Cochliopodium was described by Hertwig and Lesser (1874) and now comprises 14 species. The taxonomic position of the genus has been the subject of dispute. It has been variously described as a testate amoeba with a thin and flexible test (Cash & Hopkinson, 1909; de Saedeleer, 1934) and as a naked amoeba with stiffened pellicle (Schaeffer, 1926). Subsequently, de Saedeleer (1934) placed *Cochliopodium* in the family Testacea, and Schaeffer (1926) within the Amoebina. The most recent treatment places the genus in the Euamoebae (Patterson & Hedley, 1992) and the Class Lobosea (Phylum Rhizopoda)(Corliss, 1994). This group as now constituted includes the rhizoid amoebae which have one or more broad pseudopodia, and a firm shell. In addition, cells of *Cochliopodium* when observed with phase microscopy, possess a regular pattern on their surface (scales) that appears as a series of radiating dots and internal crystals.

The only electron microscope records of this taxon are those of Bark (1973), Kristiansen (1979) and Vørs (1992). This report is the second TEM observation of the taxon for North America, previously being reported for Florida (Wujek, 2003).

Cristidiscoid Heliozoa

Numerous, but variable round, biconvex, perforated, overlapping scales cover the cells of *Pinaciophora*. Like all filose amoebas, this genus lacks axonemes and extrusomes observed in the centrohelid heliozoa.

Pinaciophora fluviatilis Greeff   Fig. 4.

First reports of this organism for the U.S., under the name of *Potamodiscus kalbei* Gerloff, were from Alaska (Manton & Sutherland, 1979) and Mississippi and Ohio (Gaardner *et al.*, 1976). Gaardner *et al.* showed it was incorrectly described as a centric diatom. It has since been reported from the U.S. Great Lakes (Wee & Millie, 1983) and New York (Douglas & Smol, 1987). I observed it from two sites in Louisiana (Table 2). Other EM reports include both marine and freshwater habitats in Europe (Thomsen, 1978; Belcher & Swale, 1978), Canada (Nicholls, 1983b), Antarctica (Takahashi, 1981), and The Netherlands (Roijackers & Siemensma, 1988).

The cells of *Raphidiophrys* are coated with curved, spindle-shaped scales. Eighteen species are recognized (Mikrjukov, 1994c).

Raphidiophrys capitata Siemensma & Roijackers   Fig. 5.

Synonyms for this taxon include *Raphidiophrys elegans* Hertwig & Lesser (1874), *Sphaerastrum conglobatum* Greeff (1969), and *Raphidiophrys orbicularis* Nicholls (1985) according to Siemensma and Roijackers (1988b)

EM observations worldwide include: Japan, but not identified (Takahashi, 1959), Argentina (Thomasson, 1963), U.S. (Bardele, 1981; Smol, 1987), Canada (Nicholls, 1985; Nicholls & Dürrschmidt, 1985), Australia (Croome, 1987) and The Netherlands and Sweden (Roijackers & Siemensma, 1988b). I observed it both in Mississippi and Louisiana (Table 2).

Raphidiophrys intermedia Penard   Fig. 6.

The only EM observations are from Canada, Chile, New Zealand and Malaysia (Nicholls & Dürrschmidt, 1985), Australia (Croome, 1987) and The Netherlands and Sweden (Roijackers and Siemensma, 1988b). I observed it only once (Table 2).

Polyplacocystis marginata (Siemensma) Mikrjukov   Fig. 7.

Originally described as *Raphidiophrys marginata* Siemensma (1981), Mikrjukov (1996b) transferred the species to his newly described genus, *Polyplacocystis*, which contains five species. Cells are covered with one or several types of spindle form or flat siliceous scales. The flat scales are placed mainly in a tangential direction and have circular or smooth texture of the upper surface. Radial elements in the periplast are absent. As *Raphidiophrys marginata*, it was reported by Nicholls and Dürrschmidt (1985) as occurring in Canada, Chile, New Zealand, and Sri Lanka and by Roijackers and Siemensma (1988b) from The Netherlands. I observed it in Louisiana and Texas (Table 2).

Centrohelid Heliozoa

The genus *Acanthocystis* contains more species than any of the other Centrohelida. The genus, erected by Carter (1863), is wide spread with members occurring in both freshwater and marine habitats. Cells tend to be round covered by siliceous spine scales with a layer of overlapping body scales.

Acanthocystis dürrschmidtidae sp. nov. Fig. 8.

Diagnosis: cells 35-40 µm (based on a whole mount). Periplast comprising scales of two types, plate and spine scales (Fig. 8). Protoplast unknown. Plates scales are elliptical to broadly ovate, ca. 4-4.5 x 2-2.5 µm, with a narrow rim. Ornamentation consists of an axial thickening surrounded by a distinct pattern of radial slits, each ca. 0.25 µm long and up to 0.03 µm wide, located adjacent to the axial thickening. Small granules are scattered all over the surface, sometimes regularly arranged in radial rows. A pair of ribs run more or less parallel ca. one-quarter of the way in from the rim and three-fourths from the axial thickening, thinning at the ends of the scale. Spine scales are cylindrical, 10-13 µm long, bipartite, consisting of a shaft and base-plate; shaft straight, ca.0.2 µm thick, hollow; periphery with a narrow rim.

Habitat of the type: freshwater; collected 8 March 1996 with a plankton net in a ditch on the Pearl River National Wildlife Reserve Management area, St. Tammany Parish, Louisiana, T8S, R15E, Sect. 34 (Table 1).

Type specimen: shown in Fig. 8 and deposited with the Central Michigan University herbarium (CMC) as accession no. 15093.

Etymology: the species is named in honor of Dr. Monica Dürrschmidt of Germany, a prominent worker on heliozoa in the 1980s.

Remarks: *A. dürrschmidtidae* is easily distinguished from the closely related *Acanthocystis granulata* Dürrschmidt by the well-developed radial slits next to the median thickening. In *A. granulata*, the radial slits are positioned near the margin and its plate scale's also lack the nearly marginal parallel ribs. In *Acanthocystis pertusa* Dürrschmidt, while there are radial slits close to median thickening, its plate scales lack both the scattered granules and marginal ribs.

Acanthocystis pectinata Penard em. Nicholls Fig. 13.

This is a widely distributed species, since its original report from Germany and France (Penard, 1904) and has been observed in Canada (Nicholls, 1983a), Australia (Croome, 1987), the U.S.-New York (Smol, 1986) and Chile, New Zealand, Malaysia and Sri Lanka (Dürrschmidt, 1987b). This species was observed in only one sample from Mississippi (Table 2).

Acanthocystis polymorpha Dürrschmidt Fig. 14.

Although scales of this organism were originally illustrated by Takahashi (1959) as occurring in Japan, it was not until 1985 that Dürrschmidt (1985) described it as a taxon from Chile. Its occurrence in Mississippi (Table 2) represents the first report of it for the U.S.

Choanocystis, described by Penard (1904), is a centrohelid heliozoan with tangential plate scales and radial spine scales with a cylindrical shaft. The shaft is set more or less eccentrically at the apex of an invagination or inclusion of the basal plate (Siemensma & Roijackers, 1988a).

Choanocystis aculeata (Hertwig & Lesser) Siemensma & Roijackers Fig. 16.

Originally described in the genus *Acanthocystis* (Hertwig & Lesser, 1874), it was transferred to *Choanocystis* by Siemensma and Roijackers (1988a) when they reported it from The Netherlands and recognized it as synonymous with *Acanthocystis serrata* (Nicholls, 1983). I observed it only in one sample (Table 2).

Choanocystis rotundata ssp. *rotoairense* (Dürrschmidt) Wujek comb. nov. Fig. 15.

= *Acanthocystis rotundata* ssp. *rotoairense* Dürrschmidt, 1987a, Arch. Protistenk. 133:43-44.

This is the first report since its description from New Zealand (Dürrschmidt, 1987a). It occurred in one Louisiana sample (Table 2).

Pterocystis (Siemensma & Roijackers, 1988a), as in the genus *Choanocystis*, possess tangential plate scales and radial spine scales. However, the spine scales are bilaterally symmetrical, with a cylindrical shaft and membranous base which merge into two lateral membranous wings that extend for some distance along the shaft.

Pterocystis erinaceoides (Petersen & Hansen) Page & Siemensma Fig. 9.

Since its original description from Denmark, the first using EM (Petersen & Hansen, 1960), it has been reported worldwide: Germany (Bardele, 1977), Canada (Nicholls, 1983a), Chile (Dürrschmidt, 1985), and Australia (Croome, 1986). It was observed in only one sample (Table 2).

Pterocystis fortesca (Nicholls) Siemensma & Roijackers Fig. 17.

Originally described from Canada as *Acanthocystis fortesca* Nicholls (1983a), Siemensma and Roijackers (1988a) transferred it to the genus *Pterocystis* and also placed it in synonymy with the taxon *Acanthocystis pantopodecoides* Nicholls (1983a). It has since been reported from Australia (Croome, 1986). This species was the most widely observed in this study, but only from Louisiana sites (Table 2).

Pterocystis kilianii (Dürrschmidt) Siemensma & Roijackers Fig. 18.

Initially described as *Acanthocystis kilianii* by Dürrschmidt (1987b) from Chile, Siemensma and Roijackers (1988a) transferred it to *Pterocystis* when reporting it from The Netherlands and Sweden. It has also been reported from Australia (Croome, 1987). Number Six Lake, Franklin County, Alabama was the only colleting site in which this species was observed (Table 2).

Pterocystis mikrjukovii sp. nov. Fig. 19.

Diagnosis: cells 35-40 µm (based on a whole mount). Periplast comprising scales of two types, plate and spine scales (Fig. 19). Details of protoplast unknown. Plates scales are ovoid or elliptical, ca. 1.5-2x 0.8-1.5 µm. They are patternless except for an axial thickening and lack a peripheral rim. The spine scales are almost spade-form, 4-4.5 µm long, with a flared or winged base, ca.1-1.2 µm 1-1.2 wide; the tapered shaft is straight, ca. 2 µm long, terminating with a slightly bent pointed apex. The winged base-plate has 3-4 ribs extending from the base of the shaft to the basal wing's margin. Two-five ribs are also present that do not extend completely across the basal wing. Lateral wings narrow abruptly and taper briefly terminating about two-thirds from the shaft's apex.

Habitat of the type: freshwater; collected on 18 March 1996 with a plankton net at Lake Tyler,

southeast side of Farm Road 848, Smith County, Texas (Table 1).
Type specimen: shown in Fig. 19 and deposited with the Central Michigan University herbarium (CMC) as accession no. 15094.
Etymology: the species is named after Dr. Kirill A. Mikrjukov, prominent Russian researcher of heliozoa who tragically died 29 April 2000.
Remarks: The spine scales of *Pterocystis mikrjukovii* most closely resemble those of *Pterocystis paliformis* (Dürrschmidt) Page & Siemensma. The major differences being *P. mikrjukovii* spine scale basal wings possess ribs which are lacking in the patternless *A. paliformis,* and the lateral wings are not parallel and taper toward the shaft and do not narrow abruptly and terminate subapically.

Pterocystis paliformis (Dürrschmidt) Page & Siemensma Fig. 12.

As with a number of other *Pterocystis* species, this taxon was originally described in the genus *Acanthocystis* (Dürrschmidt, 1987b). This is the third country in which this species has been observed (Table 2); it has previously reported as occurring in Chile and New Zealand (Dürrschmidt, 1987b).

Pterocystis pinnata (Nicholls) Siemensma & Roijackers Fig. 20.

Siemensma and Roijackers (1988a) transferred this taxon from its original description as *Acanthocystis pinnata* Nicholls (1983). Since its initial description from Canada (Nicholls, 1983a), it has been observed in Chile and New Zealand (Dürrschmidt, 1987b) and Sweden (Siemensma & Roijackers, 1988a). I observed it in only one Alabama sample (Table 2).

Pterocystis striata (Nicholls) Siemensma & Roijackers Fig. 21.

Nicholls (1983a) originally described this taxon as *Acanthocystis striata* from Ontario, Canada. It has subsequently been observed from Australia (Croome, 1986) and Chile, New Zealand and Germany (Dürrschmidt, 1987b). I observed it from three Louisiana locations (Table 2).

Raphidocystis cells tend to be round and covered with cup-shaped scales in addition to many radiate tubular scales.

Raphidocystis flabellata (Dürrschmidt) Page & Siemensma Fig. 11.

Although described from Chile, it has been reported from New Zealand, Germany and Canada (Dürrschmidt, 1987b). Its occurrence in Lake Cherokee, Texas, represents its first report for the U.S. (Table 2).

Raphidocystis flabellata ssp. *novae-zelandiae* (Dürrschmidt) Wujek comb. nov. Fig. 10.

= 1987 *Acanthocystis flabellata* ssp. *novae-zelandiae* Dürrschmidt, Arch. Protistenk. 133: 21-48.

This is the first report (Table 2) of this taxon outside of New Zealand (Dürrschmidt, 1987b), its type locality.

Raphidocystis tubifera Penard Fig. 22.

Since its original description from France (Penard, 190), electron microscopic reports include Rees *et al.* (1980) from England and Canada, Nicholls & Dürrschmidt (1985) Canada, Chile, New Zealand, Malaysia and Sri Lanka, Croome (1986) Australia and Finlay *et al.* (1988) England.

Unidentified scales

The species list given above is not exhaustive. I observed a number of other scales, but insufficiently as to emerge with a clear concept of their identities. Collections and observations representing other seasons and from other Gulf Coast regions will yield additional species.

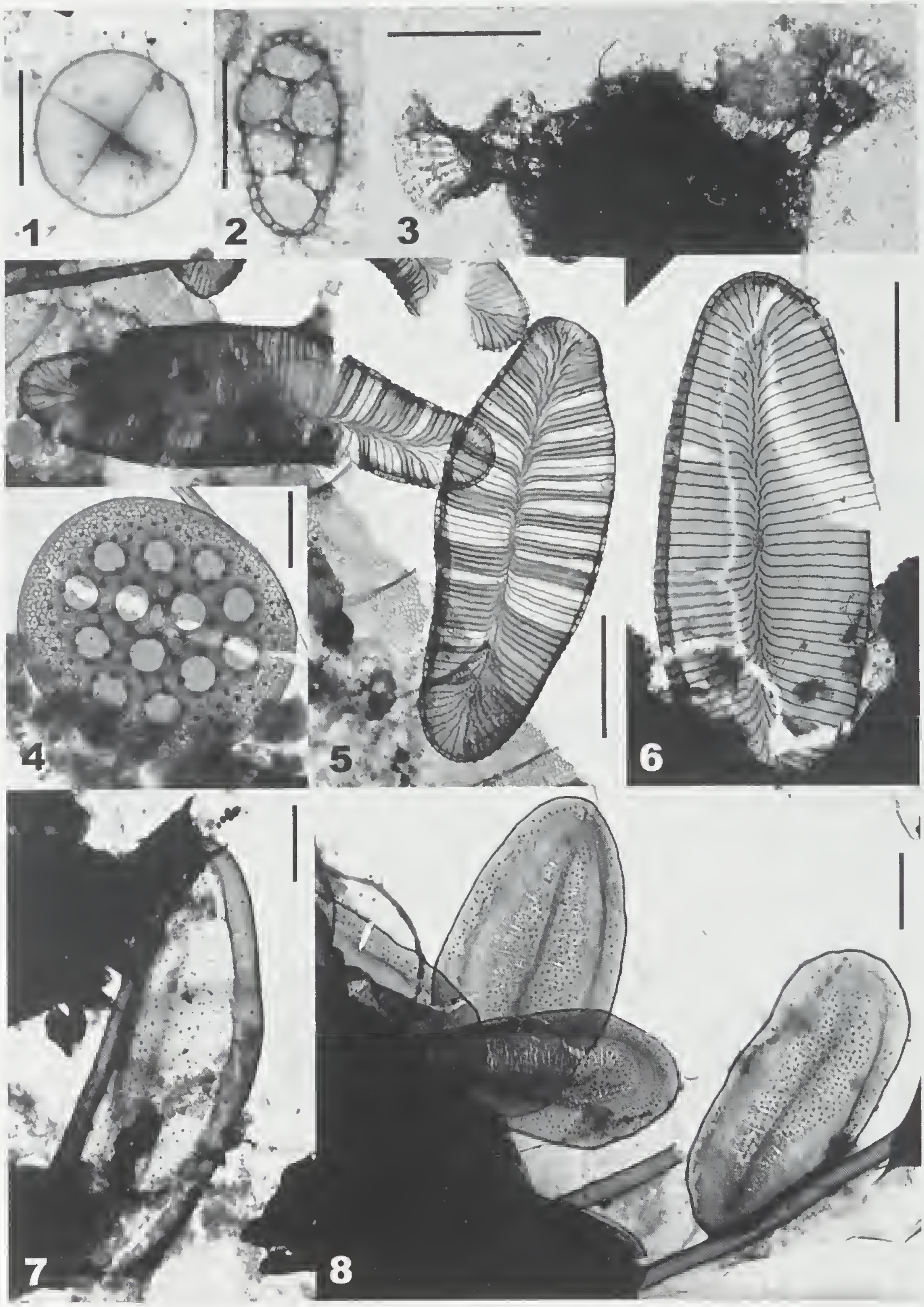
Table 1. Gulf Coast collection sites containing scaled heterotrophs from Alabama, Mississippi, Louisiana and east Texas, 29 February-19 March 1996.

Sample/Location			pH	Temp. (°C)	Conductivity (μS/M)
Alabama					
Sample number					
Colbert County - 29 February					
11	Size More	T4S, R9W, Sect. 18	7.4	8.5	83
Franklin County - 1 March					
14	Number Six Lake	T6S, R11W, Sect. 26	7.8	12.7	43
17	Cedar Creek Reservoir	T6S, R1W, Sect. 21 & 28	8.2	17.1	185
19	Bear Creek Reservoir	T8S, R14W, Sect. 2	7.9	11.4	51
Marion County - 1 March					
22	Lake Buttahatchee	T11S, R11W, Sect. 8	7.5	9.9	40
Lauderdale County - 3 March					
30	Winn Dixie Pond	T2S, R11W, Sect. 34	6.8	17.2	341
Mississippi					
Oktibbeha County 5 March					
23	Moon Lake	T18N, R13E, Sect. 12	6.4	18.4	64
Webster County 6 March					
27	American Legion Lake	T20N, R10E, Sect. 6	8.9	23.1	32

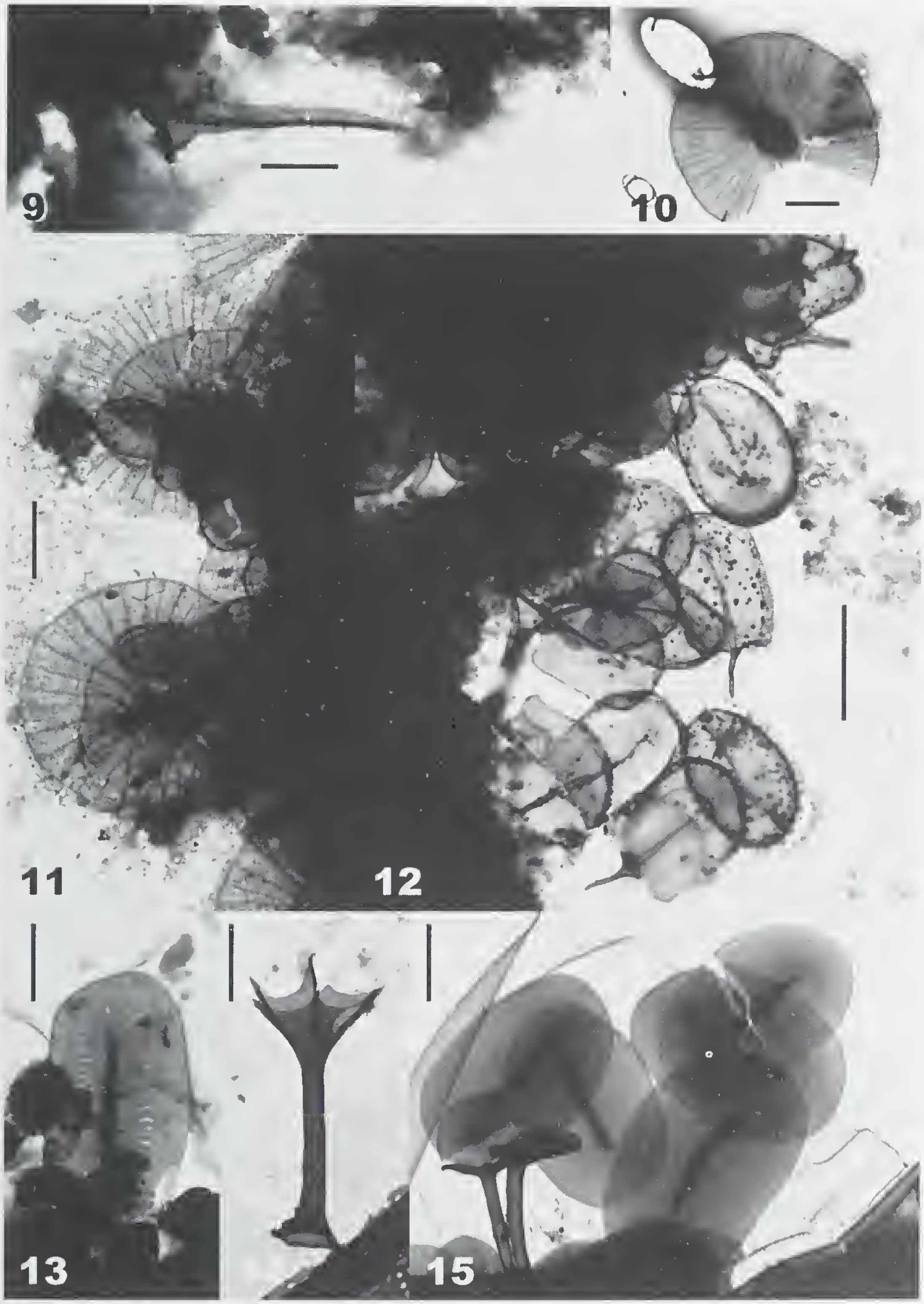
Louisiana					
St. Tammany Parish 8 March					
2	Ephemeral Pond	T9S, R15E, Sect. 20	6.9	8.6	43
3	Pearl River Nat. Wildlife Mgr. area, end of Indian Bayou Road	T8S, R15E, Sect. 3	6.5	8.6	44
4	Ditch on N.W.R.	T8S, R15E, Sect. 34	7.3	12.1	86
5	N.W.R., end of Oil Road	T8S, R15E, Sect. 10	8.0	13.4	72
8	Bayou Gouche	T15S, R20E, Sect. 10	7.2	13.6	140
Lafourche Parish 8 March					
13	Bayou Boeuf	T14S, R18E, Sect. 12	6.8	18.4	259
St. Mary Parish 8 March					
15	Lake Palourde	T15S, R13E, Sect. 36	7.7	20.9	249
Assumption Parish 8 March					
16	Lake Verret at Shell Beach	T13S, R13E, Sect. 12	7.1	17.3	285
17	Ephemeral pond, road to Lake Verret	T13S, R13E, Sect. 11	6.8	17.1	361
Tangipahoa Parish 12 March					
20	Dead Lake, elbow off Tangipahoa River	T7S, R9E, Sect. 18	7.1	17.1	50
St. Tammany Parish 12 March					
22	Pond, on loop off Tchefunta River rest stop, north side	T7S, R11E, Sect. 17	6.6	19.9	122
Bossier Parish 15 March					
24	Ditch, La Hwy 154/US 71.	T15N, R11S, Sect. 11	7.1	23.4	127
Beinville Parish 15 March					
30	Kepler Creek, La Hwy 507	T15N, R7W, Section 16	6.35	25.5	13.8
Caddo Parish 16 March					
37	James Bayou	T21N, R16W, Sect. 15	6.6	23.7	138
40	Noah Tyson Park	T22N, R15W, Sect. 1	4.7	23.2	884
Desoto Parish 17 March					
41	Smithport Lake	T13N , R12W , Sect. 4	6.7	21.4	183
Texas					
Shelby County - 17 March					
1	Toledo Bend Reservoir, southwest of County 139 bridge		6.8	24.3	371
2	William Roberts Pond, Shelbyville		6.7	21.2	117
Rusk County - 19 March					
15	Lake Cherokee, arm crossing Farm Road 1716		6.7	16.7	92
Smith County - 19 March					
21	Lake Tyler, southeast side of Farm Road 848		6.7	18.2	95

Table 2. Scaled protistan taxa observed from Gulf Coast collections, 1996. An asterisk indicates a new record for the U.S. See Table 1 for locations.

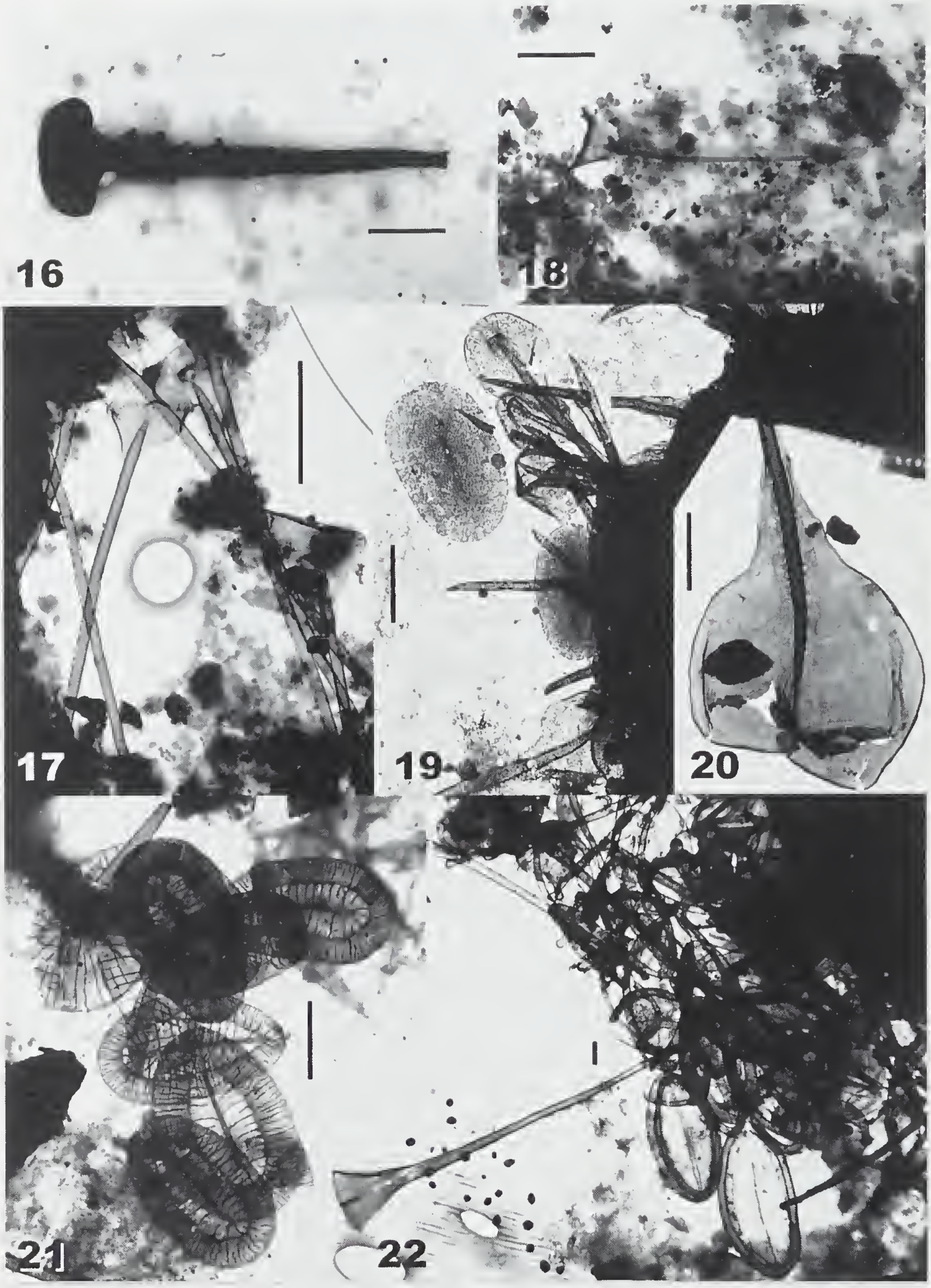
Taxon	Location
Heterotrophic Flagellate	
**Cyathobodo crucifera*	AL-22; MS-23
Ciliate	
Lepidotrachelophyllum fornicus	LA-8
Rhizopod Amoeba	
Cochliopodium bilimbosum	LA-30
Cristidiscoid Heliozoa	
Pinaciophora fluviatilis	LA-2, 15
Raphidiophrys capitata	LA-2; MS-27
**Raphidiophrys intermedia*	MS-27
**Polyplacocystis marginata*	LA-22; TX-1
Centrohelid Heliozoa	
**Acanthocystis dürrschmidtidae*	LA-17
**Acanthocystis pectinata*	MS-11
**Acanthocystis polymorpha*	MS-27
**Choanocystis aculeata*	LA-4
**Choanocystis rotundata* ssp. *rotoairense*	LA-40
**Pterocystis erinaceoides*	AL-17
**Pterocystis fortesca*	LA-8, 13, 15, 16, 17, 20, 24, 40
**Pterocystis kilianii*	AL-14
**Pterocystis mikrjukovii*	TX-21
**Pterocystis paliformis*	TX-15
**Pterocystis pinnata*	AL-19
**Pterocystis striata*	LA-3, 5, 40
**Raphidocystis flabellata*	TX-15
**Raphidocystis flabellata* ssp. *novae-zelandiae*	LA-38
**Raphidocystis tubifera*	AL-30; LA-2, 22; TX-2



Figures 1-8, scales of heterotrophic protists. 1. *Cyathobodo crucifera*. 2. *Lepidotrachelophyllum fornicus*. 3. *Cochliopodium bilimbosum*. 4. *Pinaciophora fluviatilis*. 5. *Raphidiophrys capitata*. 6. *Raphidiophrys intermedia*. 7. *Polyplacocystis marginata*. 8. *Acanthocystis dürrschmidtidae*. Scale bars = 1µm.



Figures 9-15, scales of heterotrophic protists. 9. *Pterocystis erinaceoides*. 10. *Raphidocystis flabellata* var. *novae-zelandiae*. 11. *Raphidocystis flabellata*. 12. *Pterocystis paliformis.* 13. *Acanthocystis pectinata*. 14. *Acanthocystis polymorpha*. 15. *Choanocystis rotundata* ssp. *rotoairense*.
Scale bars = 1μm.



Figures 15-22, scales of heterotrophic protists. 16. *Choanocystis aculeata.* 17. *Pterocystis fortesca.* 18. *Pterocystis kilianii.* 19. *Pterocystis mikrjukovii.* 20. *Pterocystis pinnata.* 21. *Pterocystis striata.* 22. *Raphidocystis tubifera.* Scale bars = 1µm.

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THE CAUSES OF MID-YEAR BUDGET SHORTFALLS AND THEIR IMPACT ON EDUCATION FUNDING IN ALABAMA, 1930-2001

Changhoon Jung
Assistant Professor
Department of Political Science
Auburn University
7080 Haley Center
Auburn, AL 36849
Tel: 334-844-6172
Email: jungcha@auburn.edu

ABSTRACT

This paper examines the causes of periodic mid-year budget shortfalls and its impact on education funding in Alabama during 1930-2001 period. Among all, the Alabama case shows that unbalanced revenue structure (underutilization of local property taxes and heavy reliance on a state sales tax), excessive earmarking practices, and the lack of reserve fund contributed to the periodic mid-year education budget shortfalls in the state. The result is a persistent inadequate funding of K-12 schools and the unpredictable operation of K-12 schools in the state.

INTRODUCTION

Mid-year revenue shortfalls arise when estimated revenues do not materialize as projected. Causes of state and local mid-year revenue shortfalls include a downturn in a national or regional economy, inaccurate revenue projections, an inadequate tax structure (lack of a balanced / diversified tax system), sudden changes in federal or state tax codes, excessive earmarking practices, or any combination thereof (National Conferences of State Legislatures, 2001; Shannon, 1987; Suyderhoud, 1994). In a large part, revenue shortfalls are inevitable, especially in a recession as government revenues are often closely tied to business cycles.

Since most state and local governments are under constitutional or statutory constraints to maintain a balanced budget, they are required to resolve revenue shortfalls and avoid potential deficits. Ways of managing revenue shortfalls vary. They include the imposition of short-term or stopgap measures, cutting the budget, increasing revenues, and implementing some combination of these strategies (Levine, Rubin, and Wolohojian, 1981; National Conferences of State Legislatures, 2001). The choice of strategy largely depends on the amount of time remaining in the fiscal period and the severity of the shortfall (National Conferences of State Legislatures, 2001).

As the U.S. national economy showed signs of a slowdown in 2001 after more than seven consecutive years of strong economic performance, 11 states recorded mid-year revenue shortfalls by June 2001 and implemented budget cuts in FY 2001 (National Association of State Budget Officers, 2001). The eleven states include Alabama, Connecticut, Kentucky, Louisiana, Mississippi, Missouri, New Hampshire, North Carolina, Ohio, Virginia, and West Virginia. In responding to revenue shortfalls, different states adopted different strategies.

Interestingly, Alabama has more frequently reported mid-year revenue shortfalls than any other state in the past (National Conferences of State Legislatures, 2001; Harvey, 1989; Public Affairs Research Council of Alabama, 2001b). A close look at the state reveals that many of its past revenue shortfalls can be largely attributed to its revenue structure and budget rules. Specifically, Alabama's Budget and Financial Control Act of 1932 contains a provision that makes no appropriation payable in full unless there are sufficient funds to meet it during a budget year (Pilegge, 1978). Thus, when actual revenue collection falls below estimated revenue, the governor is required to restrict allotments to prevent an overdraft or deficit by prorating funds without discriminating against any department, institution, commission or other state agency (across-the-board cut). This practice which is called "proration" has negatively affected the general government operation, and especially K-12 schools and higher educational institutions by periodically cutting the appropriated budget for these institutions (Harvey, 1989).

This paper explores the causes of mid-year budget shortfalls and its impacts on education funding in Alabama during 1930-2001 period. The next section briefly examines the revenue structure and major functional expenditure category in the state. Section three reviews trends of budget shortfalls and then analyzes the causes of periodic mid-year revenue shortfalls in the state. Section four explores the impact of periodic mid-year budget shortfalls (proration) on education funding. Section five concludes the paper with a discussion of the theoretical and policy implications of this study.

REVENUE STRUCTURE AND MAJOR FUNCTIONAL EXPENDITURE IN ALABAMA

Alabama maintains five major operating funds.[1] The two largest of these are the general fund and the education trust fund. The general fund is used for ordinary expenses of the executive, legislative, and judicial departments of the state government, debt service on certain general obligation bond issues, and capital outlay. About 36 kinds of taxes go into the general fund, the largest sources being the insurance company premium taxes, interest on state deposits, interest earnings, oil and gas lease and production taxes, corporation taxes, cigarette taxes, state property taxes, and alcoholic beverage control taxes (Alabama Legislative Fiscal Office, 2001). In FY 2000-01, the size of appropriation of the general fund was $1.4 billion, which is 25% of the total operating budget (Alabama Executive Budget Office, 2001).

The education trust fund is the largest operating fund in the state. The fund was separately established in 1927 in order to provide funding for public education. The fund is used for the support, maintenance, and development of public education, debt service and capital improvements relating to educational facilities, and other functions related to educating the state's citizens. K-12 education, public library services, performing and fine arts, various scholarship programs, education regulatory departments, and two-and four-year colleges and universities are also all funded by the education trust fund (Alabama Legislative Fiscal Office, 2001). About 12 tax sources are deposited into the education trust fund, the largest being income taxes, sales taxes, utility taxes, and use taxes. In FY 2000-01, the total size of appropriation of the education trust fund was about $4.3 billion. This is three times larger than the total appropriation size of the general fund, and makes up 75% of the total operating budget (Alabama Executive Budget Office, 2001).

Table 1. Major Revenue Sources in Alabama, FY 1999-2000 (unit: $000's)

Source	Amount	Percent of Total
Taxes	**6,029,326**	**49.5**
General Sales & Use Tax	1,705,281	14
Income Tax	2,256,618	18.6
Gasoline Tax	385,236	3.2
Tobacco Tax	66,431	0.5
Utilities Tax	191,830	1.6
Alcohol Beverage Control Board	66,770	0.5
Insurance Companies (fees and gross premium licenses)	191,830	1.6
Motor Vehicle License	55,443	0.4
Corporation franchise	84,751	0.7
State Beer Tax & County License	49,636	0.4
General Property	173,649	1.4
All Other Taxes	1,060,451	17.5
Licenses, Permits and Fees	**469,307**	**3.8**
Nontax Receipts	**5,409,904**	**44.3**
Federal Grants and Reimbursements	4,257,589	34.8
Other Revenues	1,152,315	9.5
Total Receipts	**12,192,623**	**100**

Source: State of Alabama Department of Finance, Annual Report, Fiscal Year, 1999-2000

Table 1 shows major revenue sources in Alabama during FY 1999-2000. Own source revenues (taxes, licenses, and other revenues) constituted about 62.8 percent of the total revenue. Due in part to the state's relatively low revenue capacity, Alabama service delivery substantially relies on federal grants. Federal grants made up about 34.8 percent of the total operating budget in FY 1999-2000. To further delineate, Alabama obtained 49.5 percent of its revenues from tax sources and 50.5 percent from non-tax sources (including federal grants) during the FY 1999-2000. The state relies on about forty tax sources, most of which generate insignificant amounts of revenue (Alabama Legislative Fiscal Office, 2001). Like most states, Alabama derives the bulk of its tax receipts from three major taxes: the general sales and use tax (28 % of total tax receipts), the income tax (37.4%), and the motor-fuel (gasoline) tax (6.3%). These three accounted for 72 percent of state tax revenues and 36 percent of the total revenue in FY 1999-2000. In addition, taxes on tobacco products, public utilities, insurance companies, corporations, and property constitute 11.7% of the tax revenue and 5.8 % of the total revenue as Table 1 illustrates.

To understand the structural causes of frequent mid-year revenue shortfalls in Alabama, a brief examination of the tax base, tax rate, and earmarking practices of major tax revenue sources is in order. Income tax was the most productive tax in Alabama in FY 1999-2000. Personal income tax rates range from 2 percent on the first $500 of taxable net income to a maximum of 5 percent on amounts over $6,000. The gross income applicable to state income tax starts at $4,000, which is the lowest threshold in the nation (Alabama Legislative Fiscal Office, 2001). The corporate income tax is a flat 6.5 percent applied to both domestic corporations as well as out-of-state firms doing business in Alabama. Except for a small amount set aside for property tax relief, all personal and corporate income taxes are earmarked by law for the payment of public school teachers' salaries.

General sales tax, which once was the most productive revenue source, is 4 percent rate. The sales tax is applied to most consumer purchases, including food and medicine. Alabama and New Mexico are the only two states that do not exempt sales tax on food and medicine (Hovey and Hovey, 2001). Some services, such as laundry and dry cleaning, barbering, and doctor and dentists' fees, are exempt. Still, taxing food and medicine illustrates the regressivity of the sales tax in the state. About 90 percent of the sales tax and all of the use tax is earmarked for the education trust fund.

Gasoline and motor fuel taxes constitute the third largest tax revenue source. The state imposes a tax of 17 cents per gallon. A minor portion of these proceeds is distributed to the State Water Safety Fund and the Seafood Fund, while 45% goes to the Public Road and Bridge Fund and 55% to the counties and municipalities for road construction and maintenance. A separate motor fuel tax of 8 cents per gallon on diesel is entirely credited to the Public Road and Bridge Fund for state highways (Alabama Legislative Fiscal Office, 2001).

In Alabama, tobacco is subject to a variety of state taxes. These range from 16.5 cents per pack of cigarettes to 2/10th of a cent on small cigars. Nearly half of this revenue is earmarked for education funding, but some is set aside for mental-health programs and Department of Pensions and Security (welfare). The remainder is credited to the general fund (Alabama Legislative Fiscal Office, 2001).

Property tax is an extremely underutilized revenue source in Alabama. The tax is levied on the real and personal property. Under the constitutionally mandated classification scheme, properties are taxed at different percentages. Utility properties are assessed at 30 percent (assessment ratio) of the "fair and reasonable market values", agricultural, forest, and residential properties at 10 percent, and all other property at 20 percent of fair and reasonable market value (Alabama Legislative Fiscal Office, 2001). In addition, all private passenger automobiles and motor trucks are assessed 15 percent of the value of the automobile. With the overall assessment ratio being one of the lowest in nation (especially residential property), Alabama derives the smallest percentage of total state and local tax collections from its properties. About 45 percent of all property in the state is classified as residential or agricultural and 41 percent is classified as commercial. Primarily a local government tax, the state rate is only 6.5 mills ($6.5 per $1,000 assessed value). The revenue from 3 mills of this tax is set aside for the education trust fund and 3.5 mills are credited to the general fund (Alabama Legislative Fiscal Office, 2001).

Motor vehicle license taxes are imposed on all types of vehicles. Seventy-two percent of these proceeds are deposited into the Public Road and Bridge Fund, and 21% goes to counties and municipalities for the construction and maintenance of public highways and streets. All receipts from driver's license fees are assigned to the general fund, and earmarked for public safety purposes (Alabama Legislative Fiscal Office, 2001).

In addition to the major tax sources discussed above, Alabama employs more than 30 other kinds of taxes, only a few of which are productive. Among these are the corporation franchise tax, the beer tax, the tax on gross receipts of public utilities, and a privilege license tax on insurance companies. The state imposes a 4 percent tax on gross receipts of utilities, which is the leading revenue producer among these other taxes. After allocating a small portion of the proceeds to the Special Mental Health Fund, the bulk goes to the education trust fund (Alabama Legislative Fiscal Office, 2001). Insurance companies are levied an annual fee, plus a tax based on premiums collected. These revenues, almost $191,829,856 in FY 1999-2000, constitute the third largest source of income for the general fund.

Table 2 summarizes major revenue sources that were deposited into the general fund in FY 1999-2000. The size of the general fund was $1.1 billion. Investment income (17.8%), excise and sales taxes (14.4%), insurance premium taxes (13.6%), corporation taxes (7.2%), property taxes (6.9%), and driver and motor vehicle licenses constituted the major revenue sources for general government functions. Table 3 shows the major revenue sources for the education trust fund. The size of the education trust fund was $4.1 billion, which was almost three times higher than the general fund. Income taxes (54.2%), sales taxes (32.3%), and utility taxes (6.7%) made up the largest portion of the fund.

Table 2. General Fund Revenue Sources (FY 1999-2000)

Source	Amount (in 000's)	% of total
Investment Income	201,315	17.8
Excise, Sales & Use Taxes	162,359	14.4
Insurance Premium Tax	153,993	13.6
Corporation Taxes	85,053	7.2
Property Taxes	78,322	6.9
Drivers & Motor Vehicle Licenses	72,734	6.4
Liquor Taxes, Licenses, & Profits	56,806	5.0
Oil & Gas Production Taxes	49,652	4.4
Other Licenses, Permits, Fees	51,378	4.5
Other Taxes	144,017	12.7
Other Revenues	76,449	6.8
Total Revenues	**1,132,078**	**100**

Source: State of Alabama Department of Finance, Annual Report, Fiscal Year, 1999-2000

Table 3. Education Trust Fund Revenue Source (FY 1999-2000)

Source	Amount (in 000's)	% of Total
Income Tax	2,230,141	54.2
General Sales Tax	1,328,332	32.3
Utilities Tax	274,263	6.7
General Use Tax	181,845	4.4
Other Taxes	98,634	2.4
Total	**4,114,375**	**100**

Source: State of Alabama Department of Finance, Annual Report, Fiscal Year, 1999-2000.

The single largest source of non-tax revenue in the state is federal aid. The amount the state receives from various block or categorical grants is approaching $4.3 billion per year (Alabama Legislative Fiscal Office, 2001). Federal dollars are spent on health, welfare, education, employment services, planning, energy, and many routine government operations.

Major functional expenditure

Table 4 breaks down the major categories of state spending during FY 2000. The total expenditure was $11.3 billion. As in other states, spending on public health (32.6%) and welfare (social services--10.1%), education (30.7%), and highways (transportation—8.6%) constituted the "big three" items in Alabama. Next were the protection of persons and property

(4.9%), general government (3.9%), and aid to local governments (2.8%). The average composition of expenditure pattern does not seem to be far off from other states in Alabama (National Association of State Budget Officers, 2001).

Table 4. Alabama Expenditures, FY 1999-2000 (unit: $ 000's)

Purpose	Amount	Percent of Total
Health—Physical and Mental	3,698,846	32.6
Education and Cultural Resources	3,484,666	30.7
Social Services	1,145,938	10.1
Transportation	962,205	8.6
Protection of Persons and Property (Law enforcement, business, regulation, military etc.)	558,140	4.9
General Government	440,908	3.9
Distributions to Local Government	322,978	2.8
Capital Outlay	319,549	2.8
Debt Service	303,437	2.7
Others	108,561	0.9
Total Expenditures	**11,345,528**	**100**

Source: State of Alabama Department of Finance, Annual Report, Fiscal Year, 1999-2000

TRENDS AND CAUSES OF MID-YEAR REVENUE AND BUDGET SHORTFALLS

As in most states, Alabama has a constitutional balanced budget requirement. To meet the balanced budget requirement, the state constitution requires the governor to declare across-the-board-cuts in the general fund and the education trust fund in any fiscal year that estimated revenues are not met. Functions of the state government are classified as either essential or nonessential, and proration applies to nonessential functions first. Also, certain appropriations made from the education trust fund are not subject to proration and must be paid in full. These include appropriations to teachers' retirement system, employees' retirement system, veterans' education benefits, state employees' health insurance, social security, unemployment compensation, debt service, the advanced technology foundation, and departmental receipts.

The proration provision was established in the Budget and Financial Control Act (Fletcher Act) in 1932 in order to prevent the frequent deficits that the state had been experiencing. Since its enactment, the proration has been periodic, as Table 5 illustrates. The table shows that proration has plagued the state approximately every four years. To date, proration has been declared for 8 fiscal years for the general fund and 14 fiscal years for the education trust fund. When the economy was in a deep recession, the probability of proration for both funds rose, as reflected in the past several fiscal years (FY 1936-37, FY 1985-86, FY 1990-91, FY 1991-92). However, unlike other states, the periodic and frequent revenue shortfalls and budget cuts in Alabama could be attributed to other than just cyclical recessions.

Table 5. Years of Proration and Percentage Cut

Fiscal Years	General Fund	Education Trust Fund
FY 1936-37	34.43%	-----
FY 1949-50	-----	4.8%
FY 1950-51	-----	1.0%
FY 1955-56	6.0%	-----
FY 1956-57	-----	2.76%
FY 1957-58	-----	7.82%
FY 1958-59	-----	3.54%
FY 1959-60	-----	8.35%
FY 1960-61	-----	14.14%
FY 1962-63	3.0%	-----
FY 1978-79	-----	2.98%
FY 1979-80	-----	6.14%
FY 1980-81	-----	3.57%
FY 1982-83	15%	-----
FY 1985-86	3%	4.21%
FY 1990-91	2.60%	6.50%
FY 1991-92	5.50%	3.0%
FY 1992-93	3.20%	-----
FY 2000-01	-----	6.20%

Source: Alabama Executive Budget Office.

Causes of Mid-year Revenue Shortfalls

The causes of revenue shortfalls and the resulting prorations in Alabama can be attributed to cyclical recessions, an unbalanced tax structure, excessive earmarking practices, poor revenue estimate techniques, the absence of a stabilization fund, or a combination of these factors. Each of these causes will be briefly analyzed.

First, several prorations were due mainly to a recession or a slowdown of the national or regional economy. When the national or regional economy is in a deep recession or slowdown, the actual revenue collection falls short of the estimated revenue. This is due to shrinking economic activity and the resultant reduction in the tax base. Prorations in the mid-1930s, mid-1980s, early 1990s, and 2001 fall into this category. One state government cannot do much to reverse the national or regional recession trend. The buildup of a budget stabilization fund as occurs in most other states might have helped Alabama lessen the severity of proration.

Second, much of Alabama's frequent proration in education trust fund can be attributed to a centralized and unbalanced revenue system. Alabama is one of only a handful of states heavily dependent on state funding for elementary and secondary education (Hovey and Hovey, 2001; Harvey, 1989). In the state's 127 school districts, 9.1 percent of funding came from the federal government, 25.4 percent from local tax sources, and 65.5 percent from state taxes in the 1998-1999 school year (Public Affairs Research Council of Alabama, 2001b). Compared to the national average of 43 percent of local funding for elementary and secondary education, Alabama's local school support is one of the lowest in the nation. This is especially true even in states ranked below Alabama (e.g., Hawaii, Michigan, North Carolina, and New Mexico) which have statewide revenue sources to fund their local schools (Hovey and Hovey, 2001).

As noted previously, local property taxes were underutilized for school support, while the state sales tax (37% of the education trust fund in FY 1999-2000) and all of the income tax (54%) are heavily utilized to fund K-12 schools in the state. These taxes are highly sensitive to business cycles (elastic) and, when the economy becomes sluggish, so does the revenue collection. That is, when the economy slows, the size of actual revenue collection falls short of the estimated revenue. On the other hand, property tax is a relatively stable revenue source since it is less dramatically affected by the business cycle in a short period.

The root of Alabama's inadequately low use of property tax for local school support can be traced to its state constitution, which was written in 1901 (Pilegge, 1978; Hovey, 1989). It is the longest and most amended (more than 700 amendments) in the nation. Also, Alabama and Vermont are the only states that do not permit local home rule power (Bowman and Kearney, 2002). The framers of the 1901 constitution, mostly wealthy landowners, sought to protect their interests by keeping property taxes low (Grafton and Permaloff, 1985). An increase in local property taxes requires not only a local popular vote, but also a favorable vote of the entire state legislature. As a result, unless there is support in the legislature, the passage of a local property tax referendum does not guarantee a property tax increase. Reflecting this strict limit on property tax increases, per capita annual property taxes in 1997 in Alabama were only $240, the lowest in the nation, while the national average was $817 (Hovey and Hovey, 2001). As a percentage of personal income, property taxes were 1.19 in Alabama (the lowest in the nation), while the national average was 3.35. Even if the state tripled the property tax, Alabama would remain the nation's lowest property tax state. Taxing property at the national average would mean an additional $600 million per year for education and other vital state services (Sumners, 1998). Due to this underutilization, Alabama's K-12 programs must be disproportionately reliant on the state education trust fund, which is very sensitive to business cycles. Unless the state permits adequate use of property taxes for school support (or finds new revenue sources), proration will continue to hit the state periodically. The sales and income tax is already too high and regressive, so not much help can be found there.

Third, as suggested earlier, another culprit in the periodic proration in Alabama is its excessive earmarking practices. Alabama has earmarked more state taxes (87%) in the past than any other state (Fiscal Planning Services, 2000). Compared to the national average of 30 percent earmarking, Alabama's rate of earmarking is the highest in the nation (Fiscal Planning Services, 2000; Public Affairs Research Council of Alabama, 2001). Even compared to the second and the third highest earmarking states (Nevada 65% and Tennessee 60%), Alabama records an excessively high degree of earmarking practices. Under excessive earmarking, transfers between the general fund and the education trust fund are impossible-- even when a budget surplus is available in a given fund. The excessive earmarking practice and its resultant inflexibility denies governors and legislators the fiscal maneuverability to direct resources to the areas of greatest need. A high degree of earmarking often results in the state spending money regardless of the efficacy of such expenditures (Fabricius and Snell, 1990). As such, it would be better if the decision on how to spend state revenues would be made annually by the governor and state legislature. Thus far, however, efforts to abandon the excessive earmarking practice in the state have been launched without success. This stems largely from a fundamental mistrust of the state government in Alabama (Grafton and Permaloff, 1985;

Harvey, 1989). However, as long as the state maintains a high degree of earmarking practices, citizens may not expect their government to make responsible decisions and to react intelligently to changing fiscal situations. It is interesting to note that the earmarking of the education trust fund was actually designed to guarantee a certain level of revenue for education. Consequently, the sales tax was earmarked in 1936-37 for education, and it helped schools from the disastrous effects of the Great Depression. A state income tax was earmarked specifically for public school teachers' salaries in 1945 in order to support grossly underpaid teachers (Harvey, 1989). However, it should be noted that education funding is still not fully met partly due to underutilization of available revenue sources such as local property taxes in the state (Harvey, 1989; Public Affairs Research Council of Alabama, 2001b).

Fourth, inaccurate or optimistic revenue forecasts have played a role in periodic proration in the past. Alabama uses consensus revenue forecasts agreed upon by the Executive Budget Office, the Center for Business and Economic Research at the University of Alabama, the Alabama Legislative Fiscal Office, the Alabama Department of Revenue, the Center for Government and Public Affairs at Auburn University at Montgomery, and national and regional private economists (Alabama Executive Budget Office, 2001). Although they use some kind of econometric models, their method is not clear. Also, since the revenue forecast is not based on last year's actual revenue collection, an optimistic revenue forecast tends to overestimate the actual revenue collection (Alabama Legislative of Fiscal Office, 2001). Thus, a more realistic, flexible, and accurate revenue estimate would help prevent frequent mid-year revenue shortfalls in the state.

Fifth, the lack of a reserve fund (budget stabilization fund) in the state worsens the proration. If the state had maintained a reserve fund and made annual deposits to the account, it might have eased proration because the reserve fund can be spent to weather revenue shortfall years as occurs in most other states. Indeed, the Alabama legislature passed a law in 1988 (Education Trust Fund Proration Prevention Act), requiring an annual deposit to the reserve fund. The law required that the legislature set aside $21 million the first year and $8 million each succeeding year until $75 million was in the reserve fund (Public Affairs Research Council of Alabama, 2001b). However, it contained an escape clause under which the legislature could avoid putting any money in the reserve fund, if two-thirds of the members agreed an emergency existed and the money needed to be spent immediately. The reserve fund worked well initially. For example, when proration hit the education trust fund in 1991 and 1992, the money in the reserve fund helped ease the across-the-board cuts for K-12 schools and higher education (Opelika-Auburn News, February, 2001, 5A). But, after 1992, the legislature passed a resolution each year declaring that an emergency existed due to chronic underfunding of K-12 schools. Therefore, money that would have gone to the reserve fund was spent on raises, buses, and other items. Finally, in 1999, the legislature rewrote the law to delete the requirement of making an $8 million annual deposit into the reserve fund. The reserve fund may not have been enough to prevent proration, but it would have helped. It should be noted that most states (45) have established and operated reserve funds one form or another (National Association of State Budget Officers, 2002).

THE IMPACT OF PERIODIC MID-YEAR BUDGET SHORTFALLS ON EDUCATION FUNDING

The issues of adequate and equitable funding for K-12 education were addressed in *The Alabama Coalition for Equity v. Guy Hun*t in Alabama (Sauser and Ward, 1998). In 1993, Circuit Court Judge Gene Reese ruled schools were inequitable because educational opportunities differ immensely among systems without "constitutionally sufficient justification." Further, he stated that schools were inadequate and, thus, failed to meet the standards or achieve the purposes of public education mandated by the Alabama Constitution. The Circuit Court ruling was accepted by Governors Hunt and Folsom, and Judge Reese ordered that a remedy be implemented. However, Governor Fob James, who assumed office in 1995, asked the Circuit Court for rehearing. Upon denial of the rehearing and an order to implement the Remedy Plan, an appeal was made to the Alabama Supreme Court. The Supreme Court affirmed the lower court's decision in January 1997. Further, the Court overturned the existing Remedy Plan and gave the state legislature one year to fashion a new remedy. Finally, in December 1997, the Supreme Court ruled that the state should have reasonable time to fashion a remedy (Sauser and Ward, 1998). This left the remedy wholly in the hands of the legislature and little progress has been made. Thus, the school system remains largely inadequate and inequitable (Public Affairs Research Council of Alabama, 2001b).

A critical reality is that the resolution of these problems will require additional funding. It is estimated that Alabama needs as much as $ 2 billion (one billion for infrastructure improvement and one billion for program improvement) for the implementation of corrective measures (Sauser and Ward, 1998; Public Affairs Research Council of Alabama, 2001b). Unless the state increases the existing tax rates, eliminates numerous tax exemptions, finds new revenue sources, or uses a combination of these measures, the relatively low-performing Alabama economic growth will not provide the resources to resolve the school funding problems. In addition, since the state's constitution prohibits the issuance of general obligation debt, the use of the debt is possible only through constitutional amendment, which is very difficult to accomplish.

As noted previously, Alabama is only one of a handful of states heavily dependent on state funding for its education. In the state's 127 school districts, 65.5 percent of funding was from the state education trust fund, while the national average was about 43 percent in the 1998-1999 school year. Local support was only 25.4 percent in Alabama. Of Alabama's $4.3 billion pre-proration education appropriation in the FY 2000-2001 budget, $2.7 billion (63%) was appropriated for K-12 schools and $1.03 billion (24%) went to higher education ($805 million for four year colleges and $227 million for two year colleges), with the rest (13%) reserved for education agencies and related programs (Alabama Executive Budget Office, 2001).

The primary local funding sources for K-12 schools are property taxes and local sales taxes. Alabama lawmakers have authorized local governments to adopt 15 mills of property tax effort but they reduced that requirement with a 10 mill equivalency for local support. This 10 mill equivalency means that local districts are required to raise the equivalent of 10 mills, from any source available; most districts use local sales, as well as property tax revenue. Local districts may use other tax resources to meet this minimum funding requirement. The state's Foundation Program supplements funding at the local level to bring funding per pupil to the approved level specified by the Southern Association of Colleges and Schools (Public Affairs Research Council of Alabama, 2001b). The purpose of a foundation program is to guarantee the level of revenues provided for each student. To further provide for education, local districts may adopt additional local taxes and/or millage. The maximum authorized property tax millage currently is 52.9 mills in Mountain Brook City School district which is located in suburban Birmingham (Public Affairs Research Council of Alabama, 2001b).

In part because the property assessment ratio is the lowest (10% in the case of residential property) in the nation (Hovey and Hovey, 2001), most Alabama school districts find the state mandated minimum spending levels are insufficient and provide supplementary local sources (Harvey, 1989; Public Affairs Research Council of Alabama, 2001b). All districts use local property taxes as a supplement and three-fourths of the school systems use local sales taxes, which average one percent. However, due to the property wealth disparity among school districts, the opportunity for equitable access to education has become greatly skewed in favor of school districts that can generate greater levels of tax revenue--wealthier school districts (Public Affairs Research Council of Alabama, 2001b). These revenue differences put students in poor districts at a disadvantage, as the poorer school systems struggle to make ends meet. Many rural and urban school systems fail to provide adequate classroom supplies, computers, and paper products. Although these districts are subsidized by both the state and federal governments, the subsidies hardly equalize the disparities (Public Affairs Research Council of Alabama, 2001b). Since the state legislature has not established equalization aid, the differences remain higher between poor systems and wealthy systems.

In order to understand the relative underfunding of schools in the state, it is worth comparing Alabama to its regional neighbors in terms of revenue capacity and revenue efforts. Since state and local taxes and tax rates are byproducts of political, and socio-economic development over time, it is useful to set a benchmark through which we can compare and contrast relative tax burden and revenue efforts. Table 6 shows per pupil revenue and state and local tax burdens to support the services in 15 Southern Regional Education Board (SREB) states in 1999. Alabama ranks 10th in per capita income. When comparing the state and local tax burden per capita of Alabama with the SREB states (second column of the table), Alabama ranks last. In fact, Alabama ranks last (50th) nationally, which means that the per capita tax burden in Alabama is the lowest. Alabama's state and local tax burden per capita is less than 88 percent of the tax burden in the SREB region in 1994 and this trend continues in 1999 (Harvey, 1998). Another meaningful comparison is the state and local tax burden expressed as a percentage of personal income, as depicted in the third column of the table. By comparing tax collections to personal income, the differences in per capita income (wealth) in the various states are eliminated. It is no surprise that Alabama ranks next to the bottom (14th) in the SREB region. While the difference in per capita amounts among the states is small, if Alabama had collected taxes at the weighted average of its contiguous states (Mississippi, Tennessee, Georgia, and Florida) in 1994, the result would have been $1. 86 billion in increased collection (Harvey, 1998). The table clearly illustrates that Alabama is underutilizing its tax capacity. The state's unbalanced tax structure, low tax base, and low tax effort (tax rate) explain the lower taxes.

Responses to FY 2001 Proration

In February 2001, Governor Siegelman declared a $266 million revenue shortfall out of the $4.3 billion education trust fund appropriation for FY 2000-2001 as the estimated revenue (sales and income taxes) fell short of actual revenue collection (Opelika-Auburn News, February 3, 2001, 5A). To prorate $266 million, a 6.2% across-the-board cut on K-12 and higher education was required. $180 million proration was assigned to K-12 schools and $86 million was cut from higher education. In response to the governor's proration on K-12 schools, the Alabama Association of School Boards filed a lawsuit challenging the amount of the cut. Montgomery County Circuit Judge Tracy McCooey ruled that the governor's order violated the statutory and constitutional guarantee of equal and adequate education (Opelika-Auburn News, February 9, 2001, 3A). Her decision was based on the notion that funding to K-12 schools cannot be cut because they are an essential function of the state government. This

Table 6. Revenues and Taxes of 15 Southern Regional Education Board States (1999)

Regions and States	Per capita personal Income	State & Local Taxes Per Capita	State & Local Taxes as % of Personal Income	Public School Revenue Per Student
1. Alabama	22,987 (10)	**1,916 (15)**	**8.3 (14)***	5,272 (12)
2. Arkansas	22,244 (13)	2,143 (12)	9.6 (8)	5,184 (13)
3. Florida	27,480 (3)	2,545 (5)	9.3 (11)	6,825 (3)
4. Georgia	27,340 (4)	2,552 (4)	9.3 (9)	6,292 (8)
5. Kentucky	23,237 (9)	2,377 (6)	10.2 (2)	6,548 (6)
6. Louisiana	22,847 (12)	2,303 (8)	10.1 (3)	5,983 (9)
7. Maryland	32,465 (1)	3,126 (1)	9.6 (7)	7,966 (2)
8. Mississippi	20,688 (15)	2,057 (14)	9.9 (4)	4,925 (15)
9. North Carolina	26,003 (6)	2,557 (3)	9.8 (5)	6,463 (7)
10. Oklahoma	22,953 (11)	2,240 (11)	9.8 (6)	5,713 (11)
11.South Carolina	23,545 (8)	2,187 (10)	9.3 (10)	6,624 (4)
12. Tennessee	25,574 (7)	2,079 (13)	8.1 (15)	4,968 (14)
13. Texas	26,858 (5)	2,344 (7)	8.7 (13)	6,552 (5)
14. Virginia	29,789 (2)	2,675 (2)	9.0 (12)	5,899 (10)
15. West Virginia	20,966 (14)	2,183 (12)	10.4 (11)	8,047 (1)

Source: Data calculated and compiled from several sources. Per capita personal income data were collected from *State Fact Finder 2001* and state & local taxes per capita and public school revenue per student were gathered from Public Affairs Research Council of Alabama's website pages (http://parca.samford.edu/). Figures in parenthesis represent the rank in each category.

means that colleges and universities will receive 18.5 percent budget cuts to satisfy the $266 million proration, as the governor cannot touch K-12 budgets. The absence of new revenue could lead to layoffs, reduced course offerings, and tuition hikes in higher education institutions (Opelika-Auburn News, February 9, 2001, 3A). Based on the court order and the attorney general's opinion, Governor Siegelman offered a 3.76 percent cut for K-12 schools and 11.12 percent for higher education (Opelika-Auburn News, February 3, 2001, 5A). However, colleges and universities appealed the order to the Supreme Court, arguing that protection of K-12 education imposed an improperly higher burden on them. Finally, the Alabama Supreme Court ruled that the cuts must be applied equally. To offset the loss, the state legislature passed a $110 million bond issue. The 2001 proration illustrates the painful process of budget cut, as it pitted K-12 schools against higher education institutions.

Impact of Proration on Education Funding

Table 7 shows past education budget cuts due to proration. The amount and percentage of proration varies. The largest budget cut was $266 million in FY 2000-2001, and the largest percentage cut was in FY 1960-1961 (14.14%). The average percent cut for the 14 fiscal years was 4.76%. Although an average cut of 4.76% seems low, the mid-year proration has had a devastating effect on the smooth operation of schools that have been chronically underfunded in the past. State law mandates that public school employee salaries and fringe benefits, which are contractually protected, cannot be reduced through proration. Since salaries and fringe benefits typically constitute 80-90 percent of school operating funds, the burden of proration falls on the remaining10-20 percent of a school system's operating budget.

Then, a school system can expect an actual loss in buying power of roughly 5-10 times the stated rate of proration in percentage terms (Montgomery Advertiser, September 26, 2001, 1A).

Table 7. Proation of the Education Trust Fund from FY 1950 to FY 2001

Fiscal Year	Appropriations	Actual Payments	Amount of Proration	Percent
FY 1949-50	61,146,787	58,538,969	2,936,331	4.80%
FY 1950-51	61,830,284	61,213,139	612,116	1.0%
FY 1956-57	111,909,970	108,971,628	2,891,615	2.76%
FY 1957-58	117,133,706	108,505,065	8,521,369	7.82%
FY 1958-59	119,953,322	115,971,947	3,948,197	3.54%
FY 1959-60	146,652,905	135,294,565	11,352,687	8.35%
FY 1960-61	151,323,637	131,531,371	19,792,266	14.14%
FY 1978-79	1,208,441,090	1,180,979,319	29,670,397	2.98%
FY 1979-80	1,250,808,779	1,190,317,907	60,887,044	6.14%
FY 1980-81	1,373,820,964	1,329,491,118	39,988,286	3.57%
FY 1985-86	2,216,157,991	2,136,512,263	79,645,729	4.21%
FY 1990-91	2,717,865,357	2,558,206,830	159,436,465	6.50%
FY 1991-92	2,701,780,621	2,621,045,355	67,826,684	3.0%
FY 2000-01	4,311,265,964	4,047,439,569	263,826,396	6.2%

Source: Governor's Executive Budget Office. Actually, proration was initially declared in FY 1982-83 at 10.0% and in FY 1986-87 at 5.0%. However, these declared years of proration were later cancelled as the economic condition improved and receipts to the education trust fund were sufficient for full payment of appropriations. Due to carryover balances, reversions, and/or non-proratable appropriations, the amount of proration will not be equal to the difference between appropriations and payments.

This can be illustrated by the 6.2 percent proration in FY 2001. When Governor Siegleman's 6.2 percent proration was declared in February 2001, it was triggered in March 2001. Since the Alabama fiscal year starts on October 1 and ends September 30, the March proration leaves only seven months to recoup the loss. This means the remaining monthly payments to education agencies must be reduced by 10.6 percent to balance the budget by the end of September (Opelika-Auburn News, February 3, 2001, 5A).[ii] And the 10.6 percent applies to only 10-20 percent of the remaining operating account. Depending on the size of school system's budget, this could result in a loss of almost 70 percent of all state and local operating funds during the last seven months of the year. These percentages are far beyond what can be recouped through simple belt-tightening in an individual school system (Opelika-Auburn News, February 3, 2001, 5A). The major purchases made with operating funds include utility services, books, classroom supplies, and building maintenance. All of these expenditures are important to school functions. Unless the school system has significant local funding or reserves, it faces troubled times. Local funds or borrowing are the only sources of money to replace the loss of state dollars that occurs in proration.

Most local school districts are underfunded and seldom have reserve funds (Montgomery Advertiser, September 26, 2001, 1A). Neither can most local governments support the school system with restricted revenue sources. Few local governments impose temporary local sales taxes of 0.5 to 1% to provide money for school districts. Further, total state and local sales tax rates in Alabama range from 7 to 9.5 percent, which makes it difficult to impose an additional tax increase (Public Affairs Research Council of Alabama, 2001a).

Consequently, issuing short-term or long-term debt seems to be the only alternative for many school districts. The Alabama Department of Education reported that 49 of 128 school systems will have to borrow funds to continue operation through the end of FY 2000-2001 (Montgomery Advertiser, September 26, 2001, 1A).

CONCLUSION

This case confirms the literature arguing that revenue structure (e.g., lack of balanced and diversified revenue system) and budget rules (e.g., balanced budget requirement, excessive earmarking practices) influence government expenditures (National Conferences of State Legislatures, 2001; Shannon, 1987; Suyderhoud, 1994). This study shows that much of Alabama's periodic revenue shortfalls and the attendant budget cuts (proration) can be largely ascribed to an unbalanced /inadequate revenue structure and excessive earmarking practices. The root cause lies in the antiquated state constitution. The lack of home rule power and excessive earmarking practices provided for in the constitution and statutes make it difficult for local governments to cope with the underfunding of schools and revenue shortfalls. The dominant conservative political culture has failed to revise the obsolete constitution and refused to face reality. Governor Siegleman's attempt to install a lottery to improve education funding failed in 1999 due to a strong challenge by religious groups (Montgomery Advertiser, September 26, 2001, 1A). The prevailing anti-tax mood (specifically as to property tax increases) has also prevented progress in the education funding structure in the state.

This case provides both theoretical and policy implications. First, it suggests that a balanced revenue structure and revenue utilization are very important for adequate and proper funding of government services. Centralization of school funding by state government with a heavy reliance on economically sensitive income and sales taxes while maintaining inadequate local school support can lead to frequent education revenue shortfalls. Second, it is clear that excessive earmarking practices can place undue inflexibility on the government funding system. With almost 90 percent of its revenue sources earmarked, the state cannot be expected to cope with a revenue crisis. Third, an inaccurate revenue estimate system and the lack of a reserve fund can further worsen the situation.

For adequate and proper education funding in Alabama, reform in the tax structure must be considered. The state must decrease its dependence on sales and income taxes, and rely more on local property tax. Alternatively, it must find new revenue sources to adequately fund schools. Constitutional reform allowing local freedom to choose property tax rates or to raise new revenue sources must be accomplished. Excessive earmarking must be repealed in order to enable the state and local governments to effectively and efficiently cope with any revenue crisis. Finally, the state must enhance revenue estimate techniques and reestablish a reserve fund to offset any future prorations. Revenue shortfalls in state and local governments are not new. In the past, most state and local governments have experienced revenue shortfalls mainly due to a fluctuating economy. In order to prevent revenue shortfalls and attendant budget cuts, many state and local governments have established a reserve fund (or contingent fund). In addition, state and local governments have developed and relied on sophisticated revenue estimate methods. While some states have made progress in avoiding frequent revenue shortfalls by enhancing revenue estimate techniques and budget systems, Alabama has made little progress in either regard.

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NOTES

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[i] The five operating funds include general fund, education trust fund, property fund, pension trust funds, and Alabama trust funds.

[ii] 6.2% times for 12 month equals 10.6% times for 7 months.

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NON-POINT SOURCE POLLUTION AND LAND USE PATTERN LINKAGE: A WATERSHED APPROACH

Ellene Kebede
Department of Agricultural & Environmental Sciences
210 Campbell Hall
Tuskegee University
Tuskegee, AL 36088
Phone: (334) 724-4522
Email: kebede@tusk.edu

Jianbang Gan
Department of Forest Science
2135 TAMU
Texas A&M University
College Station, TX 77843
Phone: (979) 845-5059
Email: j-gan@tamu.edu

Zewdu Gebeyehu (Corresponding Author)
Department of Chemistry and Geology
Columbus State University
4225 University Avenue
Columbus, GA 31907-5645
Phone: (706) 569-3025
Email: Gebeyehu_Zewdu@colstate.edu

ABSTRACT

Nutrient run-off and siltation are the main cause of non-point source pollution (NPSP) in US waterways. EPA has set a total maximum daily load (TMDL) of nutrient concentration in a given body of water and watershed approach to reduce NPSP. This study develops a model that integrates land use pattern and nutrient concentration in the creeks that drain into the J.B. Converse Lake watershed in Alabama, and to identify the sources of NPSP. Water quality data for three nutrient concentrations, mainly dissolved and total nitrogen and phosphorous, and the major land use, forest, pasture/hay, nurseries and urban development, in around these creeks, were used in the analysis. The results indicated that land use had impact on the concentration of dissolved and total nitrogen. The coefficient for forest had a negative sign indicating that creeks with large forest production had lower level of nitrogen concentration. Pasture/hay and urban development had positive signs, which showed that the increase in pasture/hay production and urban development increases the nutrient concentration. With refined and detailed data on water quality, land use, rainfall and soil type, the model could be used to complement watershed approach to measure the direct contribution of each land use to NPSP and assist in the management of pollution reduction.

Key Words: concentration, non-point source pollution, nutrient, land use, watershed, and water quality.

INTRODUCTION

In contrast to point source pollution, where the kind and volume of contaminants are from an identified source, non-point pollution (NPSP) is diffused pollution in an aggregate of small contaminant distributed throughout a watershed. The major source of pollutants of waterways is runoff, which includes: agriculture, construction (urban development), forest, urban storm water, and manufacturing activities. Agriculture and forestry have been identified as the largest contributors to NPSP (USEPA, 1992). Ground and surface water quality are impacted by NPSP. Surface water such as rivers and lakes are essential, not only for the supply of drinking water but also important for recreational use, and estuaries of wild habitat. Water quality is measured by the concentrations of constituent pollutants in the water (Chesters and Schierow, 1985).

The regulation to reduce point source pollution as designed by The National Pollutant Discharge Elimination System (NPDES), under the 1977 Clean Water Act (USEPA, 1980), used fines and output restrictions that resulted in pollution reduction. However, state and local agencies have struggled with the problem of NPSP of surface waters, and NPSP has been a topic of research for the last two decades. It was estimated that NPSP was responsible for more than half the water quality problems in the US (USEPA, 1992). Control programs were not easy to establish, or maintain due to the complex nature of NPSP (Hariston, 1995). Worobec and Hogue (1992) stated that the NPSP programs implemented have generally been ineffective in controlling the release of most toxic substances and chemical run-off, especially from farmland. According to Patrick et al. (1992) the solution to NPSP, siltation and nutrient loading emanating from farmlands, lies within land use management. The USEPA 1990 data showed that siltation was the major cause of river and stream impairment, affecting 36 percent of the nation's impaired river miles. Nutrients were the second most common cause of impairment, affecting 28 percent of the nation's impaired river miles. The 1992 data for Alabama were higher than the national average siltation affecting 38 percent of the damaged river miles, and nutrients affecting 42 percent (USEPA, 1992). This finding indicated that NPSP was a problem that had to be addressed in order to successfully manage Alabama's surface water quality.

Under the Clean Water Act, States were to establish State standards for water quality under the Total Maximum Daily Load (TMDL) mandated in 1979. TMDL is the total amount of a pollutant that a body of water can handle from all sources, and put limits on the amount of pollutant that can be discharged into the river, lake or stream from all sources. The cumulative effect of pollutants from different sources is not regulated directly. The potential causes of impairment of water bodies are as varied as human activities, discharges from industrial and municipal sources, urban, agricultural and other forms of landscape modifications, and changes in flow. USEPA developed Watershed Approach Framework taking into consideration both ground and surface water flow. The approach uses a hydrologically defined geographic area and involves stakeholders in the watershed in the key management decision that allows voluntary change in activities to address the specific concern (USEPA, 1996). The proposed methodology will bring together the watershed approach and TMDL process to identify the major source of pollutants among the different land use in a given location. We used this method to evaluate the major contributor to NPSP of the J.B. Converse Lake in Alabama.

J. B. Converse Lake encompasses approximately 64,000 acres and is fed by five main creeks: Big, Crooked, Collins, Hamilton, and Juniper. The location of the lake is seen in Figure 1. These creeks drain approximately 72 percent of the watershed; Table 2 provides the land use pattern. The terrain can be described as gentle to moderately rolling and the typical land uses are for forest, pasture/hay production, nurseries, urban development, and woody wetland.

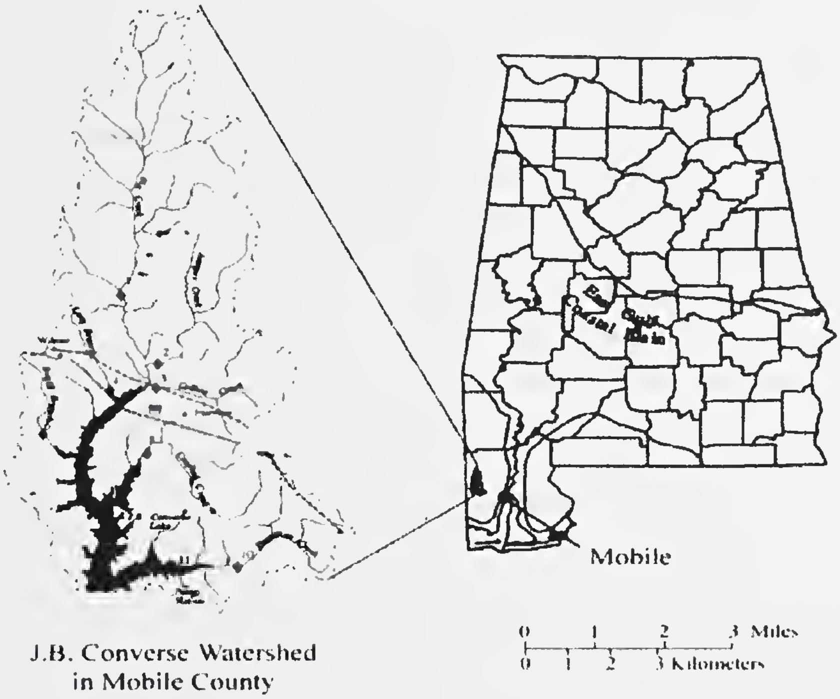

Fig. 1. Location of the J.B. Converse Watershed in Mobile, Alabama
(Base from U.S. Geological Survey digital data, 1:100,000, 1983)

The watershed was selected primarily because the data were already collected by USGS, and they were ready to share the data set with us. The watershed was a relatively large area with sufficient land use activities that would allow us to evaluate the influence of each activity on water quality. The lake is a source of drinking water for the city of Mobile and it supports fish, wildlife, and recreational activities. It was not considered as polluted by USEPA, however, the water quality data from the pumping stations on the lake from 1994 - 1997 indicate a slight increase in levels of nutrient, especially nitrate (The Board of Water and Sewer Commission, 1998, unpublished). This problem, while not an immediate threat now, could be a problem in the future. An understanding of the relationship between land use and water quality will assist in the development of land use management with the intervention of improving and maintaining water quality.

This paper applied the watershed approach to identify nutrient concentration in the different creeks, and develops nutrient concentration/land use integrated model to identify the major source of NPSP in the J.B. Converse Lake watershed. It was hypothesized that the water quality in and around the watershed will be useful to assess the sources of NPSP on ground and surface water. The integrated model will be an input for the public service agencies and communities in the watershed in instituting land management practices to reduce NPSP, maintain and improve surface water quality.

THEORETICAL FRAMEWORK

The main characteristic of NPSP, according to Bailey and Swank (1983), and Chesters and Schierow (1985), was that the sources of discharge are diffused, and it was difficult to trace the origin of contaminants (Hariston, 1995). The main components of NPSP were sediments, nutrients, toxic material, and organic waste (Hariston, 1995), with sediments contributing the largest volume of transported materials. Nitrogen and phosphorous were identified as important water pollutants (Duttweiler and Nicholson, 1983). These nutrients were responsible for rapid plant growth and noxious algal blooms (Duttweiler and Nicholson, 1983; Hariston, 1995). The vegetative growth in water bodies could restrict navigation, reduce recreational value, cause fish kills, affect the taste in drinking water supplies, and incur cleaning costs. Phosphorous tended to be a sediment bound pollutant, and therefore, has a tendency to be lost with surface runoff and increase with stream discharge, while nitrogen was lost through both surface and sub-surface flow and decrease with stream discharge (Alberts and Spoomer, 1985).

Land use and other human activities can affect water quality through their impact on sedimentation, chemical loads, and watershed hydrology. Agriculture has been identified as the most pervasive of all NPSP sources in every region of the United States (Myers et al., 1985). USEPA reported that agricultural runoff affected 60 percent of impaired river miles, and was by far the most extensive source of pollution (USEPA, 1992). Agricultural production includes both cropland and livestock operations that have been sources of nutrient pollutants (Myers et al., 1985). Keeney (1989) stated that pasture/grassland acted as a source of nutrient pollutant when intensively managed and especially, if it was used to graze animals.

Osborne and Wiley (1988) studied the Salt Fork watershed in East Central Illinois and suggested that agricultural practices had a minimal effect on instream soluble reactive phosphorous concentrations. The results were similar to those obtained by Smith (1977) who studied the nutrient loading of major river catchments in Northern Ireland, and observed no relationship between phosphorous fertilizer usage and mean annual river concentrations of ortho-phosphate and total phosphate. Agricultural practices appeared to largely affect nitrate and total nitrogen concentration when fertilizer is applied within the watershed. Osborne and Wiley (1988), Tufford et al. (1998), and Hirose and Kuramoto (1981) showed that ammonium was positively correlated with croplands, however, nitrates and nitrites were not used in the area, and there was a predominance of reductive paddy fields within the basin studied.

Areas that have undergone urban development have also become sources of water pollution. Rainwater runoff from roofs, lawns, streets, industrial and other pervious and impervious surfaces of urban areas can become non-point sources of water pollution. Smith (1977) and Hirose and Kuramoto (1981) showed that the in-stream concentration of phosphate and nitrogen (nitrate and nitrite) within the streams increased with the increase in urbanization. The use of fertilizers around homes, parks, and golf courses does contribute to the nutrient content of urban runoff. Thomas et al. (1992) suggested that the part of the watershed where there is more urban development had more nitrate and phosphate concentration in streams.

Forestry generates a smaller volume of NPSP than agricultural production. The major NPSP from forestry activities was sedimentation, and this was associated with road building and harvesting. Forest density and forest type affected nitrogen fixation and uptake, and the presence of riparian forests directly regulated the amount of nitrogen reaching streams from upstream areas (Sollins et al.1980). Forested areas act as a sink, or an active transformation zone for nitrate. As the forested area increased, the nitrate level downstream decreased (Basnyat et al., 1999). Studies by Tufford et al. (1998) and Jordan et al. (1993) also demonstrated that forests were characterized by lower in stream concentration of total nitrogen and total phosphorous.

Although land use is a major factor influencing NPSP, other factors such as vegetation topography, and soil type also affect the transportation of pollutants to surface water. Johnson et al. (1997) reiterated the importance of these factors, and stated that the adsorption properties of different soil types differ in sediment transport. Sandy/gravel soils had a low nutrient adsorptive capacity and a high infiltration rate. The high infiltration rate meant that it allowed for the water to move downward toward ground water; thus, reducing surface runoff. Clay soils (clay loam), on the other hand, had high nutrient adsorption capacity and a low infiltration rate. These soils tended to erode easily resulting in a high nutrient export to surface run-off (Sonzogni et al., 1980; Miller, 1979).

According to the soil survey done by USDA/Soil Conservation Service, J. B. Converse Lake watershed is dominated by Troup soils, the upper northern region consisting of Troup-Heidel-Bama soils. This soil unit is used mainly for the cultivation of crops and pastures. The limitation of this soil unit for farming is its low water holding capacity and erosivity; however, it is considered good to fair for woodland/open land and wildlife habitat. The remainder of the watershed consists of Troup-Benndale-Smithton soils. The landscape of this area is described as nearly level to hilly, with both well and poorly drained soils, and used mainly as woodlands and pasture (Hickmen and Owens, 1980).

Rainfall influences nutrient export through both its pollutant load and its influence on runoffs. Beaulac and Reckhow (1982) suggest that run-off variability is strongly influenced by the intensity, quantity, duration and seasonal distribution of rainfall. Muir (1973) studied the factors influencing the concentration of nutrients in surface water and concluded that high concentration of nitrogen in streams during peak flows could partially be attributed to the high nitrogen concentration of rainfall. Lucey and Goolsby (1993) demonstrated the effect of rainfall on concentration of nitrates in rivers; with increase discharge, there was a dilution of nitrates in surface waters and as discharge declined, nitrate concentration increased. Alberts and Spoomer (1985) concluded that rainfall, along with plant residue and soil type, were sources of nitrogen pollution in an agricultural watershed of southwestern Iowa. This study uses stream water discharge as a proxy to rainfall. Stream discharge is high when there is heavy rainfall and low when the rainfall is low.

Empirical studies used regression analysis to assess the relationship between land use and NPSP. Studies by (Basnyat et al., 1999; Johnson et al. 1997; Tufford et al. 1998; Osborne et al. 1988; and Lynstrom et al., 1978) utilized multiple regression modeling to analyze the effect of joint land uses on different nutrient content of streams. Hill (1981) used a regression model to assess the relationship between phosphorous losses and land use, soil, and topography in a study conducted in the Duffin Creek Watershed, Canada. Johnson et al.,

(1997) used multiple regression analysis utilizing landscape factors such as geology and average slope, to determine the magnitude and direction of the interaction between land use and landscape factors, and water chemistry. More than 50 percent of the variance in total nitrogen and nitrate concentration and more than 40 percent of the variance in the phosphate concentration were accounted for by all land use and landscape factors. Basnyat et al., (1999) developed a semilog regression model to link land use/land cover and NPSP in Alabama. Their study was conducted in Baldwin County that boarders Mobile County in the east, which is the location for the watershed covered by this study. The common feature of the two locations was that the watersheds were large enough to observe the potential effect of land use on the NPSP. The land use pattern showed that forest was the dominant activity, followed by grassland and urban development.

Most literature in the past used log linear and semi log regression models to show the relationship between land use and water quality as an indicator of the source of NPSP. Multiple land use and nutrient concentration data were used in the models; however, this paper adds water discharge in the model to see if rainfall has effect on the level of NPSP, and is able to improve in the identification of the source of NPSP.

Integrated Model

The transport of NPSP downstream from particular contributing areas can be modeled using an equation that incorporates the flow of nutrients from the various land use in and around the nearest creek. The general assumption is that the concentration of soluble nutrients in the surface water is the result of the amount of residues from agricultural chemical application. Ordinary least square regression models (Greene, 2000) were used in this study to integrate land use and the concentration of nutrients to identify the source of NPSP. The model can be implicitly defined as follows:

(1) $$NPSP = f(Dis, F, N, P, U)$$

Where the dependent variable, NPSP, is the concentration of nutrient or total suspended solids from a sample collected from a creek: total nitrogen (TN), dissolved nitrogen (DN), and dissolved phosphorous (DP). The independent variables are: *Dis* water discharge, measured in cubic feet per second, *F* the percentage of land under forest, *N* the percentages of land under nurseries, *P* the percentage of land under pasture/hay, and *U* the percentage of land under urban development. The model can be explicitly written in two functional forms as:

(2) $$\log NPSP = \alpha + \beta_1 \log Dis + \beta_2 \log F + \beta_3 \log N + \beta_4 \log P + \beta_5 \log U + \varepsilon$$

(3 $$NPSP = \alpha + \beta_1 \log Dis + \beta_2 \log F + \beta_3 \log N + \beta_4 \log P + \beta_5 \log U + \varepsilon$$

Equation 2 and 3 respectively represents the log-linear function, and the semi-log functional forms. Where ε is the error term, α is the intercept, and β_1, β_2, β_3, β_4, and β_5 are coefficients to be estimated.

Based on past studies it was hypothesized that water discharge will have a positive relationship with dissolved phosphorous and negative relationship with nitrogen. Phosphorous tends to be a sediment bound pollutant, and therefore, has a tendency to be lost with surface runoff and increase with increase in water discharge to streams (Baker, 1985;

Alberts and Spoomer, 1985). When water discharge increases, nitrogen concentration declines in the stream (Baker, 1985; Lucey and Goolsby, 1993).

The coefficient for forest *(β_2)*, was expected to have a negative relationship with the nutrient concentration, for both nitrogen and phosphorous. The negative relationship for forest was based on the minimal and infrequent use of fertilizers in forestry (Jordan et al., 1993).

A positive relationship was expected to hold for the coefficients for nurseries *(β_3)*, pasture/hay *(β_4)*, and urban development (B_5). This was expected because the use of fertilizer was generally associated with these activities (Smith, 1977; Shamblen and Binder, 1996; Park et al., 1994,).

Log linear and semi-log functions were the two widely used models to relate NPSP, nutrient concentration, and land use. This study used both models and applied the selection criterion (PC- Prediction Criterion) developed by Amemiya (1980) to select the model that can best fit the given data and relationship. The selection method uses the Unconditional Mean Square Prediction Error (UMSPE) that takes into consideration the losses associated with choosing an incorrect model.

$$PC = \sigma^2\left(1 + \frac{K_1}{T}\right) \tag{4}$$

$$\sigma^2 = (T - K)^{-1}[f(x_t\beta)_t - f(x_t\hat{\beta})]^2 \tag{5}$$

When expressed in terms of R^2 is

$$PC = \sigma^2\left(\frac{T + K_1}{T - K_1}\right)(1 - R_1^2)\left(\frac{TSS}{T}\right) \tag{6}$$

Where σ^2 is standard error of the estimate, *T* number of observations, *K* number of independent variables, X independent variables, β is the coefficient to estimated, $\hat{\beta}$ is the non-linear least squares estimator of β, and TSS is total sum of squares. Adjusted R^2 incorporates a penalty for reducing the degree of freedom while revealing an improvement in fit; however, PC has higher penalty for adding variables than adjusted R^2 (Judge et al.,1988). The value for the PC ranges between 0 and 1 and a smaller value indicates the goodness of fit.

Data

The study used land use data obtained from United States Geological Survey (USGS) collected primarily from results of aerial photos and surveys (USGS, 1992). Table 2 presents the land use distribution of the five major creeks in the watershed. Forests, nurseries, and pasture/hay are the dominant land use in the watershed, but with different proportions in each creek.

Water quality data collected by USGS in cooperation with other State, Municipal and Federal agencies from 1992 through 1994 were used for the analysis (USGS, AL1992-AL1996). Water quality was sampled on a regular basis, usually biweekly and monthly, in recording stations located in each creek (Big, Hamilton, Crooked, Juniper and Collins). The parameters examined were the nutrients commonly associated with NPSP, namely dissolved nitrogen (nitrates and nitrites), total nitrogen, and dissolved phosphorous. A seasonal aggregation of the water quality data was done as follows: Winter – January to March; spring – April to June; summer – July to September; and fall – October to December. There were a total of 60 observation, four seasons for the five creeks for the period covered (1992-1994). The land used for forest, pasture/hay, nurseries, and urban development was reported as percentages of the total area covered by each creek (Table 2). The sub-watersheds covered by these creeks accounted for 66 percent of the total watershed. Since the soil was dominated by Troup soil, it was assumed to be the same for all creeks and water discharge was used as a proxy for rainfall.

RESULTS AND DISCUSSION

Summary statistics of nutrient concentration in the creeks are provided in Table 1. The table shows the annual average mean concentration of dissolved phosphorous (*DP*), dissolved nitrogen (*DN*) and total nitrogen (*TN*)) for the different creeks. The results showed that there was variation in chemistry in the creeks. Phosphorous had the least mean concentration of 0.02 mg/L for all creeks while total nitrogen had the highest mean concentration, 0.78mg/L, 0.70 mg/L, 0.68 mg/L, 0.64 mg/L, 0.44 mg/L for Crooked, Juniper, Big, Hamilton, and Collins creek respectively.

The land distribution in Table 2 showed that Crooked creek had the lowest forest cover, 46% compared to the rest of the creeks, and had the highest concentration of total nitrogen. About 73%, 61%, 59%, and 52% of the land in Big, Juniper, Collins, and Hamilton creeks were, respectively under forest production. The production of nurseries and pasture/hay requires some level of fertilizer application. Crooked creek had the highest concentration of nitrogen among the creeks. The land distribution showed that Crooked creek had the largest area of land, 47% under nurseries and pasture/hay cultivation, compared to the rest of the creeks 24%, 37 % in Big creek and Hamilton creek respectively, and 34% each in Collins creek and Juniper creek. This may be a result of the fertilizer application by the producers in the area, and the difference in land use in and around the different creeks. The water quality and the land use data were used in the regression analysis. Description of the dependent and independent variables is provided in Table 3. The prediction criterion (PC) was used to compare the prediction accuracy of the log-linear and semi-log functional forms for the given data. The result of the Prediction Criterion (PC) presented in Table 4 shows that the log-linear estimation has smaller prediction error than the semi-log estimation.

The result of the log-linear regression model for dissolved nitrogen and total nitrogen is presented in Table 5. The F statistic for dissolved nitrogen (*LNDN*) and total nitrogen (*LNTN*) models were statistically significant at 5% level and showed that there was a relationship between land use and nutrient concentration. The model for dissolved phosphorous did not show a statistically significant relationship between land use and nutrient concentration and is not reported. This may be because of the low level of phosphorous observed in the creeks. Past studies showed that phosphorous could be affected by geological factors (Thomas et al., 1974; 1992).

The regression model results for nitrogen (*LNDN* and (*LNTN*) showed that the coefficient for water discharge (*LNdis*) was significant and had the expected negative relationship with concentration. The nutrient concentration will be diluted with higher water discharge and hence a negative relation is noted. The coefficient for forest (*LNF*) had the negative sign, which indicates the inverse relationship between area of land under forest and nutrient concentration. Past studies by (Tufford et al., 1998; and Basnyat et al., 1999, 2000) had obtained similar result that is with the increase in forest area there is a decline in nitrogen concentration in the surrounding water.

Pasture/hay (*LNP*) and urban development (*LNU*) carried the expected positive sign, which shows that an increase in the production of pasture/hay and urban development would increase dissolved and total nitrogen in the lake. This implies that there was a significant use of nitrogen fertilizers in the production of hay. Past literature showed that the type of management of grasslands impacts the amount of nitrogen run-off to streams (Keeney, 1989). Intensive management practice in pasture/grasslands is expected to act as major source of nutrient concentration. Pasture and hay are the second major activity in the watershed and the positive relationship could be attributed to this land use.

The positive sign for urban development is consistent with past literature on urban development (Basnyat et al., 1999, 2000), which indicated that with an increase in urban development there would be more nutrient runoffs to the surrounding creeks. The main sources of pollutants are run off from streets, lawns, roofs, and industrial activities. The coefficients for nursery production (*LNN*) depicted a negative relationship with nutrient concentration. The inverse relationship in this watershed could be due a limited use of fertilizers in the nursery production.

Basnyat et al. (2000) used a whole watershed and contributing zone models, with nitrate concentration in the creeks as the dependent variable, and the land use: forest, residential area, agriculture and nurseries as independent variables. The contributing zone model had a higher R^2 and the expected negative sign for forest and positive for residential areas, agriculture and nurseries. This study used a whole watershed model and the same dependent and independent variables but included water discharge as one of the dependent variable and obtained the expected signs.

Table 1. Mean Nutrient Concentration in Big, Crooked, Collins, Hamilton, and Juniper Creeks (1992 – 1994) in Mg/L

Creek	Dissolved Phosphorous (DP)	Dissolved Nitrogen (DN)	Total Nitrogen (TN)
Big Creek	0.02	0.38	0.68
Collins Creek	0.03	0.20	0.44
Crooked Creek	0.02	0.51	0.78
Hamilton Creek	0.02	0.36	0.64
Juniper Creek	0.02	0.42	0.74

Source: US Geological Survey, Water Resources Data Alabama 1992 – 1994

Table 2. Percentage Land Use Distribution in the Seven Creeks of J.B. Converse Lake Watershed, Alabama, 1992.

Land use		Creeks			
	Big	Collins	Crooked	Hamilton	Juniper
Forest	72.92	59.34	46.21	52.25	61.55
Nursery	11.24	13.93	17.94	15.51	13.60
Pasture/Hay/Grass	12.8	20.87	29.44	21.78	20.5
Woody Wetlands	0.81	0	1.09	5.27	0.78
Urban	2.21	5.86	5.32	5.19	3.75
Rock/Sand Clay	0.01	0	0	0	0

Source: USGS Alabama Office, Montgomery, Alabama (unpublished), 1992

Table 3. Description of variables in the regression analysis

Variables	Description
Dependent Variables	
LNDN	log transformation dissolved nitrogen
LNTN	log transformation total nitrogen
Independent variables	
LNdis	log transformation of water discharge
LNF	log transformation of land under forest
LNP	log transformation of land under pasture/hay
LNU	log transformation of land under urban development

Table 4. Prediction Criterion for Log Linear and Semi-log Estimations

	Prediction Criterion (PC)	
Model	LNDN	LNTN
Log-linear	0.141	0.060
Semi-log	0.150	0.061

Table 5. Regression model result for dissolved nitrogen, and total nitrogen using the log-linear functional form

Independent Variables	Dissolved Nitrogen (LNDN)	Total Nitrogen (LNTN)
Intercept	-35.21** (19.72)	-18.92** (7.29)
LNdis	-0.27** (0.09)	-0.01 (0.03)
LNF	-13.60** (7.05)	-7.16** (2.61)
LNN	-15.71* (9.31)	-9.26** (3.44)
LNP	2.68* (1.61)	1.33** (0.59)
LNU	0.18* (0.08)	-0.05** (0.01)
Adj. R^2	0.49	0.30
F Value	15.16	8.14

Numbers in the parenthesis are standard deviations, * * significant at 0.01,

CONCLUSION

The results of this study indicated that land management practices had impact on the concentration of dissolved and total nitrogen in the creeks. Land under forest production, pasture/hay, and urban development had effect on the nutrient concentration in the creeks. Forest production acted as a sink for nitrates, as the proportion of land under forest product increased the nutrient concentration in the creek decreased. On the other hand pasture/hay and urban development had positive relationship with nutrient concentration. The expansion of pasture/hay production and urban development would have a potential adverse effect on water quality in the watershed. Urban development is only possible by turning land under forest or other use to residential and industrial activities that create pervious and impervious surface. Consequently, the reduction in forest, that acts as a sink for nutrients, and increase the impervious surface leads to more runoffs. Future expansion of urban development might have to be accompanied by better land management that will reduce runoffs and hence non-point source pollution.

The model developed in this study examined the relationship between water quality and land use to assist in identifying major source of pollutants. The results of the study is limited by the data and assumptions, however, with refined and detailed data on water quality, land use, rainfall and soil type, the model could be used to complement watershed approach in addressing pollution concern and making land management decisions in a given geographic area.

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INTRA-ADMINISTRATION CONFLICT: THE CIA v. THE STATE DEPARTMENT IN SOUTH VIETNAM DURING THE KENNEDY YEARS

William E. Kelly, Ph.D.
Political Science / Sociology
7004 Haley Center
Auburn University, AL 36849
Phone: 334-844-6167
E-mail: kellywe@auburn.edu

ABSTRACT

Students of foreign policy have much to learn from the controversial South Vietnam conflict. This article concentrates on the role performed by the United States Central Intelligence Agency and the Department of State before the United States engaged in a massive commitment of troops and material to South Vietnam. Thus, it is limited in it scope of concern. It is primarily concerned with the time period before 1965. The post 1965 period was quite different in terms of American activity, and this paper does not attempt to comment on it in any significant way except to note changes regarding the control of the Agency have come about. Nevertheless, the lessons learned from the pre-1965 time period regarding intra-administration conflict are still applicable. Perhaps, this is the value of history. The emergence of a clash between these two important elements in American foreign policy-making during the early years of the South Vietnam conflict appears evident. (In addition, the author concludes with suggestions for improving not only American foreign policy-making, but also with the hope that the Central Intelligence Agency pursues a policy of objectivity and detachment in its pursuit of intelligence.

The problems encountered by the South Vietnamese government during the late 1950s and early 1960s were becoming more serious each day. The internal pressure brought on by the attempted military coups and dissident elements was almost as great as the external pressure brought on by Vietcong terror raids. In the early years of President Ngo Dinh Diem's rule the Vietcong terror operations were expanded. Two theories have been advanced in explanation of the increased guerilla activity. One was that President Diem's government was performing a political and economic miracle and that the North Vietnamese could not bear the contrast. However, the more plausible reason seems to be that the populace had become so embittered toward President Diem's suppressive policies that the Vietcong decided to take advantage of their hatred.

By 1961 conditions had deteriorated to such an extent that President Kennedy sent Vice President Lyndon Johnson in May and retired General Maxwell Taylor in October to study the problem and make recommendations. There had been great concern over "politicking" in the top echelons of President Diem's army, the reluctance of Vietnam's army headquarters to give more authority to commander in the field, and the refusal to entrust responsible command positions to able young officers who demonstrated a zeal for carrying the fight to the enemy. While opposing the sending of American combat forces, General Taylor favored the dispatching of military technicians and proposed intensified training of South Vietnamese Army Forces in anti-guerilla warfare by American Rangers. (2) Whereas General Taylor emphasized the military aspects of the problem, Vice-President Johnson recommended improvement in the political, social, and economic fields. (3)

As the economic and military aid to South Vietnam increased, so did the activity of the CIA. Beginning in the spring of 1962, the Agency supervised "Operation Montagnard," the equipping and training of at least six battalions of South Vietnam Special Forces for work with mountain tribesmen in the prevention of infiltration by Communist Vietcong forces from Laos and North Vietnam for offensive clandestine operations. (4) The term "Montagnard" refers to various tribes long despised by the lowland Vietnamese. The Diem government was wary of arming them, so they were supplied with weapons outside normal Vietnamese channels. (5) The Montagnard Project was reported to have been directed by CIA station chief, John Richardson, a specialist in counter-insurgency with prior experience in the Office of Strategic Services, the American espionage organization used during the Second World War. Richardson, who worked closely with United States Ambassador Frederick E. Nolting, had an estimated two hundred agents under his command, as well as United States Army Special Forces training teams. (6) "The United States Special Forces in South Vietnam were actually a military arm of the C.I.A. Later, the Special Forces were transferred to the Military Assistance Command headed by Gen. Paul D. Harkins, and became a regular unit." (7) In 1964, an article appeared in *International Affairs* (Moscow) which commented on the role of the Agency in South Vietnam: "The CIA was deeply involved in South Vietnam long before the 14,000 U. S. troops were sent there. The CIA helped train the Vietnamese Army. And they were already close to President Diem and his brother, Ngo Dinh Nhu, before President Kennedy made his decision that a major counter insurgency operation should be launched." (8)

As noted previously, there was widespread dissatisfaction among the population with the South Vietnamese government. On July 16, 1963, this discontent erupted into violence when squads of heavily armed police and soldiers stopped a Buddhist demonstration with an all-out display of force, beating indiscriminately men, women, and children. Actions such as these brought world-wide attention to the plight of Vietnamese civilians and resulted in unfavorable publicity throughout the world. In spite of almost universal disapproval, this policy was continued. In spite of the United States' publicly announced disapproval over the suppression of Buddhist monks and other dissident elements, the regime reportedly received $250,000 per month from the Central Intelligence Agency to be used in the operation of the Special Forces units. (9) These forces which perpetrated the raids on the Buddhist pagodas were armed with CIA funds, and given the best training in jungle fighting and guerilla operations available under CIA supervision, by officers of the " . . . United States Special Forces. It was reported that support of Tung's forces was never a part of the normal United States military assistance program in South Vietnam, but was totally a CIA undertaking." (10) Critics of the Agency argued that our government's policy was against the South Vietnamese government's suppression of the Buddhist monks and that the continued suppression, as well as the continued support given by the Agency, was contrary to our national policy. They maintained that although it may not have been a direct subsidy for a religious war against the Buddhist majority, it came very close to that. (11)

The fact that the Agency did engage in military activity in South Vietnam should not be surprising. In July of 1961, *The New York Times* reported: "Despite reports to the contrary the intelligence gathering functions of the CIA, and its military operations, such as direction of the Cuban invasion, should not be split, but placed under the director of a new CIA officer who would report directly to the President's new military advisor, Gen. Maxwell Taylor." (12) The article also noted that: "All U.S. diplomats and intelligence operations overseas should be the responsibility in each capital of the American Ambassador there, and that each Ambassador should be instructed that C.I.A officials in his territory must report directly to him."(13)

The relationship between Mr. Richardson, the CIA station chief in South Vietnam, and the American Ambassador to that country, Mr. Frederick E. Nolting, is interesting to explore. It was pointed out previously that Richardson had worked closely with the Ambassador during the Montagnard project, and at that time the Ambassador did not seem to object to the military activity of the Agency. Richardson was not only closely involved with the Ambassador, he also established close contacts with members of the Diem family, such as Ngo Dinh Nhu, the brother of President Diem. (14) Thus the Agency was influential with the State Department as well as with the South Vietnamese government.

There are at least two views as to the conduct of Richardson. First, in order for him to obtain the maximum amount of intelligence, one might assume that he should have widened his scope of activities. This would include the establishment of close contacts with high-ranking officials of the South Vietnamese government and securing the collaboration of the American Ambassador in order to facilitate the performance of his duties. Yet, one might suggest that if a CIA agent is to remain objective in his analysis the agent must limit his association with government leaders of foreign countries. In this respect a typical complaint was levied against the Agency in *The Economist* which stated: ". . . the CIA cannot be counted upon for disinterested intelligence when it is closely involved in politics and personalities. Nowhere has it been more engaged in that than in Vietnam, where it has long been in the field." (15)

The relationship between Richardson and Henry Cabot Lodge, the man who replaced Nolting as Ambassador to South Vietnam, is also interesting. In the United States House of Representatives, Congressman Paul Rogers of Florida criticized the activity of the CIA in South Vietnam. His criticism, like that of other members of Congress, may have been based on a number of articles which appeared in newspapers or journals. An article which he introduced in Congress included the following comments:

> The story of the Central Intelligence Agency's role in South Vietnam is a dismal chronicle of bureaucratic arrogance, obstinate disregard of orders, and unrestrained thirst for power.
>
> Twice the CIA flatly refused to carry out instructions from Henry C. Lodge, ...
>
> In one of these instances, the CIA frustrated a plan of action Mr. Lodge brought with him from Washington, because the Agency disagreed with it.
>
> ……………………………………………………………………………
>
> 'If the United States ever experiences a "Seven Days in May" it will come from the CIA, and not the Pentagon,' one U.S. official commented caustically.
>
> ……………………………………………………………………………

CIA 'spooks' (a universal term for secret agents here) have penetrated every branch of the American community in Saigon, until non-spook Americans here almost seem to be suffering a CIA psychosis.

An American field an officer with a distinguished combat career speaks angrily about 'that man at headquarters wearing a colonel's uniform.' He means the man is a CIA agent, and he can't understand what he is doing at U.S. military headquarters here, unless it is spying on other Americans.

A surprising number of the spooks are known to be involved in their ghostly trade and some make no secret of it.

'There are spooks in the U.S. information Service, in the U.S. operations mission, in every aspect of American official and commercial life here,' one official—presumably a nonspook—said.

'They represent a tremendous power and total unaccountability to anyone' he added. Coupled with the ubiquitous secret police of Ngo Dinh Nhu, a surfeit of spooks has given Saigon an oppressive police state atmosphere.

……………………………………………………………………………………

And for every State Department aid here who will tell you, 'Dammit, the CIA is supposed to gather information, not make policy, but policymaking is what they're doing here,' there are military officers who scream over the way the spooks dabble in military operations.

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One very high American official here, a man who has spent much of his life in the service of democracy, likened the CIA's growth to a malignancy, and added that he was not sure even the White House could control it any longer. (16)

These charges are obviously difficult to substantiate without more evidence. *The New York Times* commented on the relationship between Ambassador and Richardson.

There is no evidence that the CIA Chief has directly countermanded any orders by the Ambassador. Assertions that he has are denied in all quarters here.

Rather, even amid the current controversy, it is acknowledged that the C.I.A. chief, for more than a year, has carried out the extremely difficult job of working closely with Ngo Dinh Nhu. In this aspect of his duties he has done a superior job, ... It is the basic contradiction between this role and that of intelligence chief that is at stake.

……………………………………………………………………………………

It is believed here that Mr. Lodge and the C.I.A. chief see this war effort in somewhat different lights. Likewise, they see the proper function of a C.I.A. chief in different lights. (17)

From the above comments it would appear that Lodge's concept of the role of the Central Intelligence Agency differed substantially from that of his predecessor—Ambassador Nolting. Their differences of opinion may have been a major factor which led to Richardson's transfer from Saigon to a new assignment.

During 1962 and 1963 there were many criticisms levied against the Agency which undoubtedly led President Kennedy to defend the role of the Agency in South Vietnam. The following information is taken from a transcript of President Kennedy's news conference as recorded on October 9, 1963.

> Q. -Mr. President, could you discuss some of the recent public accounts of CIA activities in South Vietnam, particularly the stories of, or reports of how the CIA has undertaken certain independent operations, ...
>
> ....
>
> A.-I can find nothing – and I've looked through the record very carefully over the last nine months and I could go back further - to indicate that the CIA has done anything but support policy. It does not create policy; it attempts to execute it in those areas where it has competence and responsibility. . . . I can assure you flatly that the CIA has not carried out independent activities but has operated under close control of the Director of the Central Intelligence ... with the cooperation of the National Security Council. So I think that while the CIA may have made mistakes, as we all do on different occasions – and it has made many successes which may go unheralded – in my opinion, in this case it is unfair to charge them as they have been charged. I think they have done a good job. (18)

A month before this news conference, President Kennedy openly suggested a change in South Vietnam policies and leadership. Question seven of his news conference of October 9, 1963, reflected his previous remarks. "Mr. President, could you say, sir, how our policy is progressing in Vietnam in meeting what you established as desirable last month ...?" (19) The President responded in part by noting: "I think we are still dealing with the same problems we were dealing with a month ago." (20) During this news conference, President Kennedy confirmed that Richardson was being transferred from Saigon to a new post. However, he referred to Richardson as a very dedicated public servant and cautioned against formulating the wrong conclusions about his transfer.

Question sixteen was in response to Senator Gruening's proposal to set up a Congressional Committee as a watchdog over the Agency. Kennedy's response was:

> As you know, there is a ... Congressional Committee in the House, and one in the Senate composed of members of the Appropriations Committee and the Armed Services Committee. They meet frequently with Mr. McCone. He also testified before the Foreign Relations Committee of the House and Senate and the General Armed Services Committee, and I think the Congress has, through that organization, the means of keeping a liaison with him.
>
> In addition, I have an advisory council . . . . I am well satisfied with the present arrangement.

Question twenty was concerned with the reports of disputes between the State Department and the CIA. Kennedy responded:

> . . . I must say that, as of today – and I think this is particularly true since General Taylor and Secretary McNamara came back – I know of no disagreement between the State Department at the top, the C.I.A. at the top, Defense at the top, the White House and Ambassador Lodge on what our basic policies will be and what steps we will take to implement them.
>
> Now, if down below there is disagreement, I think in part it would be because they are not wholly informed of what actions we are taking. Some of them are necessarily confidential, ...

It is difficult to determine how effective President Kennedy's remarks were in contradicting the criticism levied against the Agency. One author noted that they were a "belated attempt" to restore the CIA's image. (23) On the one hand, Kennedy steadfastly defended the role of the Agency, but on the other, he made it clear that there might have been some differences of opinion between the State Department and the Central Intelligence Agency. His removal of Richardson may have indicated that he was not entirely satisfied with the conduct of the Agency in South Vietnam, yet the Agency is usually at a disadvantage regarding public commentary concerning its activities due to its understandable need for secrecy.

There are at least four possible conclusions emanating from this study. First, there was need for closer coordination between the Central Intelligence Agency and the State Department. Obviously, in South Vietnam there was not enough coordination. Some progress could be made in solving this problem by re-emphasizing to the Agency that CIA operatives assigned to foreign countries are to be responsible to the Ambassador. Yet this requires the type of Ambassador who will carry out his responsibility for exercising control over CIA personnel. This study indicates that in the presence of an Ambassador who fails to exercise control, a vacuum develops in which the Central Intelligence Agency could take the initiative.

Second, this clash during the early years of the South Vietnam Conflict was not just between personalities, but involved perhaps a natural rivalry between the Central Intelligence Agency and the State Department. A rivalry among or between different Agencies is not an uncommon characteristic of our political system. However, some means other than removing personalities must be devised to present such a rivalry from jeopardizing the foreign policy of America in international affairs. By removing Richardson from his post in Saigon, President Kennedy eliminated temporarily a problem which could exist in greater magnitude in some other country.

Third, there appeared to be a problem of control over the Central Intelligence Agency. The operations of the Agency, especially if they are not carefully controlled, tend to strongly influence foreign policy, if not actually formulate it. The late General William Donovan, who served as head of the Office of Strategic Services, once noted that "no foreign policy can ever be stronger than the information on which it is based." (24) Kurt London, author of *The Making of Foreign Policy: East and West*, refers to intelligence as the crux of foreign policy making and points out that it is fuel for the machinery of international affairs.
"Without it, the machinery will slow down or idle." (25)

One recommendation to seriously consider at this time to more adequately control the Agency would be the establishment of a Joint Congressional Committee on Intelligence which has been proposed by various Congressmen and Senators. This might have the advantage of lessening some problems encountered by the Agency: an increasing lack of public confidence and criticism by various members of Congress. Naturally, the establishment of such a committee would not solve all the problems of coexistence with a secret and powerful bureaucracy, but it would be a good beginning.

The establishment of a committee designed to more closely monitor CIA activities does not represent an unpopular view. For example, Congressman Paul Rogers noted that our country has had a history of success regarding the use of a watchdog committee regarding sensitive matters. In addition, he suggested a plausible reason for its existence regarding the Agency when he pointed out that "members of Congress are regularly given highly sensitive intelligence data pertaining to foreign affairs and defense matters, and the Nation's security is not jeopardized in the least. On the contrary, this Nation's well-being is enhanced when executive sessions are held by congressional committees having jurisdiction in the military and international fields." (26)

Fourth, it is clear that the Agency can have a profound impact on the quality and effectiveness of America's role in international affairs. In performing its duty of securing intelligence the Agency must possess the objectivity and detachment from policy that will assure the most forthright reporting on international affairs. (27) Yet Richardson jeopardized his objectivity by associating too closely with the policymakers in the Diem government. He should have limited his duties to intelligence gathering and allowed the Ambassador to be the primary representative of the United States in that country. Thus, his actions may have made it possible for representatives of various international organizations and foreign countries to serious question who really represented the United States in its international conduct during the early days of the Vietnam Conflict—the Central Intelligence Agency or the State Department.

NOTES

1. David Wise and Thomas Ross, *The Invisible Government* (New York: Random House, 1964), p. 158.

2. "President Cool on Asia Trip Aid After Hearing Taylor's Report," *The New York Times,* November 4, 1961, p. 5.

3. "Johnson Pledges Help to Vietnam To Fight Poverty," *The New York Times*, May 13, 1961, p. 1.

4. Paul W. Blackstock, *The Strategy of Subversion* (Chicago:Quadrangle Books, 1964), p. 203.

5. "Gen. Taylor Sees Vietnam Efforts," *The New York Times*, September 13, 1961, p. 3.

6. Blackstock, loc. cit.

7. "U.S. Intelligence Role Is Diverse in South Vietnam," *The New York Times*, October 8, 1963, p. 21.

8. Petrov and V. Clernyavsky, "U.S. Intelligence and Foreign Policy," *International Affairs* (Moscow), October 10, 1964, p. 37. The authors quoted from an article which appeared in *The New York Times*, October 6, 1963, credited to James Reston.

9. U.S. *Congressional Record*, 88th Cong., 1st Sess., 1963, CIX, Part 12, 16522. See: Article, "CIA Allegedly Pays Nhu's Troops Despite Leader's Disfavor Here," from the *Washington Post*, January 8, 1963, introduced by Senator Morse.

10. Ibid.

11. U.S. *Congressional Record*, 88th Cong., 1st Sess., 1963, CIX, Part 14, 18602. See: article, "Arrogant CIA disobeys Orders in Vietnam,"by Richard Starnes from the *Washington Daily News*, October 2, 1963.

12. "Kennedy To Ask Bowles To Quit," *The New York Times*, July 17, 1961, p. 13.

13. Ibid.

14. Blackstock, loc. cit.

15. "CIA in Retreat?," *The Economist*, CCIX (October 12, 1963), p. 134.

16. U.S. , *Congressional Record*, 88th Cong. , 1st Sess., 1963, CIX, Part 14, 18602. See: article, "Arrogant CIA Disobeys Order in Vietnam," by Richard Starnes from the *Washington Daily News*, October 2, 1963, introduced by Congressman Rogers.

17. "Lodge and C.I.A. Differ on Policy," *The New York Times*, October 4, 1963, pp. 1,4.

18. "Transcript of the President's News Conference on Foreign and Domestic Matters," *The New York Times*, October 10, 1963, p. 18. See also: "Kennedy Defends CIA Role," *The New York Times*, October 10. 1963, pp. 1, 5.

19. Ibid.

20. Ibid.

21. Ibid.

22. Ibid.

23. Blackstock, op. cit., p. 206

24. "Intelligence: Key to Defense," by William Donovan, *Life*, September 30, 1946, p. 108.

25. Kurt London, *The Making of Foreign Policy: East and West* (New York: J.B. Lippincott Company, 1965), p. 114.

26. U.S. *Congressional Record*, 88th Cong. Ist Sess., 1963, CIX Part 3, 3087. See also: U.S. *Congressional Record*, 8th Cong., 2nd Sess., CX, Part 1, 95. See article, "The CIA is Getting Out of Hand," from the *Saturday Evening Post* by Eugene McCarthy, introduced by Senator Pell.

27. Harry H. Ransom, *Can American Democracy Survive Cold War*? (Garden City, N.Y.: Doubleday & Company, Inc., 1964) p. 168.

INTERNET SOURCES APPLICABLE TO THIS STUDY

http://www.mtholyoke.edu/acad/intrel/pentagon2/doc121.htm

http://www.cia.gov/cia/publications/facttell/index.html

See: For executive and legislative oversight of the CIA

See: CHAPTER 1

THE 1961 DECISION TO STAND FIRM IN VIETNAM

Has valuable insights into the views of various government officials regarding America's role in South Vietnam.
U.S., Congress, Senate, Committee on Foreign Relations, *The U.S. Government and the Vietnam War: Executive and Legislative Roles and Relationships, Part II, 1961-1964* (Washington: U.S. Government Printing Office, 1985)

http://www.mtholyoke.edu/acad/jntrel/pentagon2/pent11.htm

The Pentagon Papers
Gravel Edition
Volume 2
Chapter 6, "The Advisory Build-Up, 1961-1967," pp. 408-514.
(Boston: Beacon Press, 1971)

Section 1, pp. 408-457 Has a valuable commentary concerning a discussion of increasing advising activities on the part of the United States government in Vietnam.

http://www.mtholyoke.edu/acad/intrel/pentagon2/doc104.htm

Excerpts from General Taylor's report, 3 Nov. 1961, on his mission to South Vietnam for President Kennedy.

http://mcadams.posc.mu.edu/viet22.htm

Vietnam War: The Documents – 22

Kennedy And McNamara Prepare for War

As the Vietnam situation heats up, the National Security Council discusses how to fight a war in that country. It discusses diplomatic matters (contacts with the Co-Chairmen of the Geneva Conference and with Khrushchev). It also examines military considerations — some as specific as the performance of American assault rifles.

Note that Kennedy suggests "a group specially trained for guerrilla warfare."

Source: *The Pentagon Papers,* Gravel Edition, Volume 2, pp. 652-654

Reprinted from *New York limes*

Excerpts from General Taylor's report, 3 Nov. 1961, on his mission to South Vietnam for President Kennedy.

http://www.mtholyoke.edu/acad/intrel/pentagon2/doc102.htm

Memorandum for General Taylor from L.L. Lemnitzer, Chairman, Joint

Chiefs of Staff, “Counterinsurgency Operations in South Vietnam, 12
October 1961

Source: *The Pentagon Papers,* Gravel Edition, Volume 2, pp. 650-651

Note this part: “6. In this regard, there is some concern that the Thompson Mission may try to sell the Malayan concept of police control without making a sufficiently careful evaluation of conditions in South Vietnam. Additionally, there are some indications that the British, for political reasons, wish to increase their influence in this area and are using the Thompson Mission as a vehicle. Consequently, your forthcoming trip to South Vietnam is most timely. Despite repeated urging, the Government of South Vietnam has not yet written an overall national plan for counter-insurgency. The question of police or military organization for combating Viet Cong insurgency should be laid to rest in that plan. Your evaluation of this matter could have an important effect on the Governments of both South Vietnam and the United States.

http://www.mtholyoke.edu/acad/intrel/pentagon2/ps18.htm

Response to a Question on American Involvement in South Vietnam, President Kennedy’s News Conference, February 14, 1962

Source: *The Pentagon Papers,* Gravel Edition, Volume 2, pp. 807-809

President Kennedy’s News Conference, February 14, 1962, Public Papers of the Presidents, Kennedy, 1962, p. 136:

http://www.mtholyoke.edu/acad/intrel/pentagon2/doc112.htm

Memorandum to President Kennedy from Ambassador John Kenneth Galbraith on Vietnam, 4 April 1962

Source: *The Pentagon Papers,* Gravel Edition, Volume 2, pp. 669-671

http ://www.odci.gov/csi/books/vietnam/epis1.html

> The struggle in South Vietnam at best will be protracted and costly [because] very great weaknesses remain and will be difficult to surmount. Among these are lack of aggressive and firm leadership at all levels of command, poor morale among the troops, lack of trust between peasant and soldier, poor tactical use of available forces, a very inadequate intelligence system, and obvious Communist penetration of the South Vietnamese military organization.
>
> From the draft of NIE 53-63, “Prospects in South Vietnam” submitted by the Intelligence Community’s representatives to the United States Intelligence Board, 25 February 1963 (1)

As indicated by http://www.odci.gov/csi/books/vietnam/index.html

In reference to the book, CIA and The Vietnam Policymakers: Three

Episodes: 1962-1968 by Harold P. Ford.

http://www.mtholyoke.edu/acad/intrel/pentagon2/doc120.htm

Use the above for comments about the Montagnards

Michael V. Forrestal, Memorandum for the President, "A Report on South Vietnam," February 1963 Michael V. Forrestal, Memorandum for the President, "A Report on South Vietnam," February 1963

Source: *The Pentagon Papers,* Gravel Edition, Volume 2, pp. 717-725

The program to arm and train the Montagnards, which should go far toward choking off the infiltration routes, has also made progress. There are 29 U.S. Special Forces teams training Montagnards (as well as certain minority groups in the Delta), with eleven more teams on the way. By mid-autumn training camps had been set up in all the provinces bordering Laos, and a system of regular patrolling started that hopefully will one day cover the entire network of trails in the mountain regions. Under this program over 35,000 Montagnards have been trained, armed, and assisted in setting up their village defenses, the eventual goal being one hundred thousand.

http://mcadams.posc.mu.edu/viet8.htm

Vietnam War: The Documents - 8

National Security Council meeting of October 2, 1963, discusses problems with the Diem government in Vietnam.

The repressive policies of the Diem government in Vietnam were a major concern of U.S. policy makers, who felt that these policies hindered the effort to fight off the Communist insurgency. Thus the coup that toppled Diem held out the hope of an effective South Vietnamese response to the Communists.

http://www.mtholyoke.edu/acad/intrel/pentagon2/ps42.htm

U.S. Policy on Viet-Nam: White House Statement, October 2, 1963

Source: *The Pentagon Papers,* Gravel Edition, Volume 2, p. 830

U.S. Policy on Viet-Nam: White House Statement, October 2, 1963, Department of State Bulletin, October 21, 1963, p. 623:

"1. The security of South Viet-Nam is a major interest of the United States as other free nations. We will adhere to our policy of working with the people and Government of South Viet-Nam to deny this country to communism and to suppress the externally stimulated and supported insurgency of the Viet Cong as promptly as possible. Effective performance in this undertaking is the central objective of our policy in South Viet-Nam."

* * *

"5. It remains the policy of the United States in South Viet-Nam as in other parts of the world, to support the efforts of the people of that country to defeat aggression and to build a peaceful and free society."

* * *

http://mcadams.posc.mu.edu/viet23.htm

Vietnam War: The Documents -23

Kennedy's Last Press Conference — November 14, 1963.

In Kennedy's last press conference, the issue of Vietnam got considerable attention. The President made it clear that his key objective was to bring Americans home, but also to maintain South Vietnam as a "free and independent country." He expressed the hope that the recent coup would lead to "an increased effort in the war."

Conspiracists point to Kennedy's "plan to bring 1,000 Americans home before the end of 1963" as proof that he had firm plans for a total withdrawal, but here he seems less than firm even on that modest reduction.

Interested students who desire more information should be grateful to:

> Professor Vicent Ferraro who supplied copies of government documents and newspaper articles dated back to 1941.
> www.mtholyoke.edu/acad/intrel/vietnam.htm

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DISTRIBUTION AND OCCURRENCE OF SELECTED PESTICIDES IN URBAN AND AGRICULTURAL AREAS: A COMPARISON BETWEEN CENTRAL ALABAMA AND NATIONAL DATA SETS

James L. Robinson
U.S. Geological Survey
2350 Fairlane Drive, Suite 120
Montgomery, AL 36116
email: jrobinso@usgs.gov

ABSTRACT

The distribution and occurrence of selected pesticides in ground-water sampled from 30 wells located in urban areas and 29 wells in agricultural areas of central Alabama were compared to national data sets ranging in size from 600 to over 1,400 samples. The central Alabama wells were completed in sand and gravel deposits underlying the flood plains of the Alabama, Black Warrior, Coosa, and Tallapoosa Rivers. These sediments overlie and recharge the Cretaceous aquifer system in central Alabama, an important source of public and private water-supply.

The depth of the urban wells ranged from 5.6 to 29.8 meters with a median depth of 11.9 meters. The depth of the agricultural wells ranged from 6.4 to 17 meters with a median depth of 9.9 meters. Ground water from the 30 urban wells was age dated. The ground water ranged in age from 1 to greater than 45 years, with a median age of 12 years. Ground water from a subset of 8 agricultural wells was age dated. The ground water ranged in age from 14 to 34 years, with a median age of 18.5 years. The ground-water ages are consistent with the geology and hydrology of the study area and the design of the wells

The most frequently detected pesticides in the urban ground water were atrazine and its degradation products (16 samples), dieldrin (7 samples), and simazine (6 samples). The most frequently detected pesticides in the agricultural ground water were fluometuron (17 samples), atrazine and its degradation products (16 samples), aldicarb degradation products (7 samples), and norflurazon (7 samples).

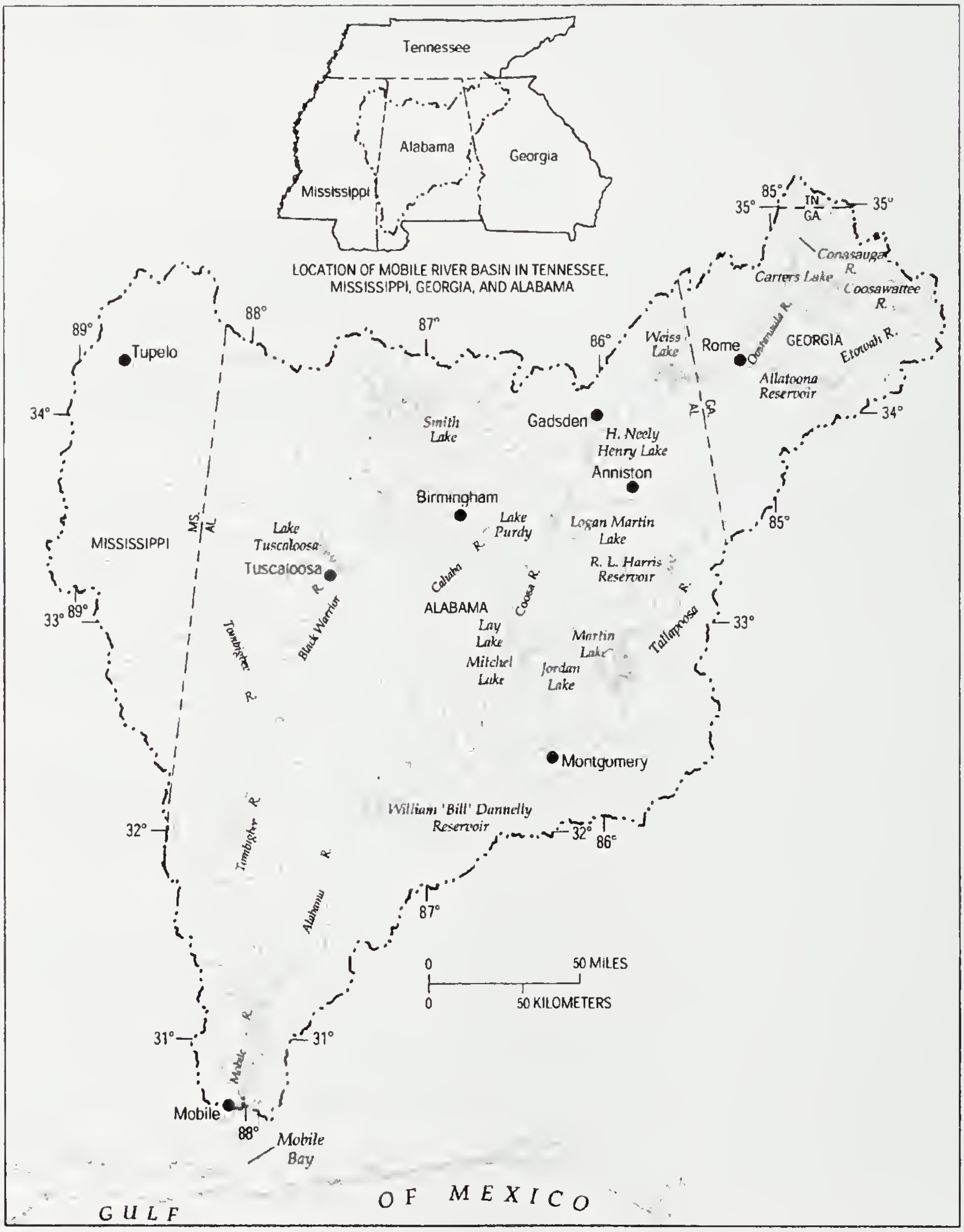
Pesticide concentrations in the Alabama and national data sets were censored to a common threshold so that detection frequencies in the data sets could be compared. Atrazine was less frequently detected in ground water in central Alabama than in the Nation; fluometuron, norflurazon, aldicarb degradation products, dieldrin, and simazine, were detected more frequently in central Alabama. The detection frequencies of pesticides in ground water in central Alabama, when compared to the national detection frequencies, are consistent with pesticide application rates in central Alabama.

INTRODUCTION

In June 1999, the U.S. Geological Survey (USGS) began a study of ground-water quality beneath urban and agricultural areas of central Alabama (Robinson, 2002, 2003). Water-quality samples were collected from 30 urban and 29 agricultural wells, and sent to the

USGS National Water Quality Laboratory (NWQL) in Denver, Colorado for analysis. The occurrence and distribution of selected pesticides in ground water beneath central Alabama were compared to national urban and agricultural data sets collected as part of the USGS National Water Quality Assessment Program (NAWQA).

The urban and agricultural study areas in central Alabama are located in the flood plains of the Alabama, Black Warrior, Coosa, and Tallapoosa Rivers (Fig. 1). The flood plains vary from less than 8 to more than 16 kilometers wide. The land surface is flat to gently rolling. Undeveloped land is covered with mixed forest and wetlands. Many small lakes in the flood plains are the result of open-pit sand and gravel mining, which is a major industry in the area.



Base from U.S. Geological Survey digital data, 1:250,000, 1994
Universal Transverse Mercator projection,
Zone 16

Figure 1--Location of the major rivers and cities in the Mobile River Basin (from Robinson, 2002).

The urban area is located in eastern Montgomery, Alabama (Fig. 1). The population of the Montgomery metropolitan area in 1998 was approximately 321,000 (U.S. Census Bureau, 2000). Land use in eastern Montgomery is primarily a mixture of high- to low-density residential, commercial, light industry, and forested areas. The urban area was developed between 1960 and 1998 (Robinson, 2002).

The agricultural area includes parts of Autauga, Elmore, Lowndes, Macon, Montgomery, and Tuscaloosa Counties in central Alabama. Land use in the agricultural area has not changed substantially in 25 to 50 years (Robinson, 2003). Mixed agriculture is typical with multiple crop types grown simultaneously on about one-third of the farms. On many farms, cotton and corn are rotated, fields lie fallow for a season, and pastures are maintained for cattle. The most common row crops are cotton, corn, soybeans, and wheat (Table 1). In 1997, the average farm size in the agricultural area ranged from 196 to 524 acres (U.S. Department of Agriculture, 2003).

Table 1. Selected 1992 and 1997 statistics for agricultural area, by county [data from the U.S. Department of Agriculture, 2003].

County	Average farm size (acres)	Acres of cotton	Acres of corn for grain or seed	Acres of soybean	Acres of wheat for grain
Autauga	301	9,956	1,035	1,381	1,340
Elmore	222	19,393	2,167	1,371	640
Lowndes	524	7,725 [a]	2,575	4,126 [a]	No data
Macon	424	5,964	1,045	455	330
Montgomery	368	1,372	975	2,241	722
Tuscaloosa	196	4,313	4,464	2,118	1,162
Total acres		48,723	12,261	11,692	4,194

[a] 1997 data not reported, data from 1992 used.

Hydrogeologic Setting

The urban and agricultural study areas are located in the Alluvial-deltaic Plain of the East Gulf Coastal Plain Physiographic Province (Sapp and Emplaincourt, 1975). Average annual rainfall in central Alabama ranges from 129 to 145 centimeters (cm) (National Oceanic and Atmospheric Administration, 1999). Rainfall is seasonally distributed, with the greatest rainfall amounts occurring during the months of December through March (about 12 – 15 centimeters per month, (cm/mo)); and the least rainfall occurring during the months of August through October (about 5 – 10 cm/mo).

The urban and agricultural study areas are underlain by alluvial and terrace deposits of sand, gravel, and clay; and in some places, sediments of the Cretaceous System comprise the surficial unit (Fig. 2). The alluvial and terrace deposits range from about 9 meters to more than 30 meters thick, and form a shallow aquifer that overlies the Cretaceous aquifer system with little or no hydraulic separation (DeJarnette and Crownover 1987; Scott and others, 1987). The Cretaceous aquifer system is susceptible to contamination from land surface because of the lack of hydraulic separation. Water quality in the Cretaceous aquifer system is important because this aquifer supplies water for many public and private wells in Alabama and Mississippi (Robinson, 2002).

System	Stratigraphic unit		Major lithology	Thickness (meters)	Hydrogeologic unit	Regi aqui syste
Quaternary	Alluvial and terrace deposits		Sand, gravel, silt, and clay	1 – 35 +	Shallow aquifer	
Cretaceous	Selma Chalk		Chalk	0 – 65 +	Confining unit	South Coast Plain aquif syste
		Eutaw Formation	Upper and lower marine sand separated by clay; consists of glauconitic sand interbedded with calcareous sandstone and sandy limestone	0 – 35 +	Cretaceous aquifer system	
	Tuscaloosa Group	Gordo Formation	Basal zone of gravel and sand overlain by lenticular beds of sand and clay	0 – 65 +		
		Coker Formation	Basal zone of non-marine sand, gravel, and clay; upper marine zone of sand and clay	175 +		
Pre-Cretaceous			Schist, gneiss	350 +	Base of fresh-water system	

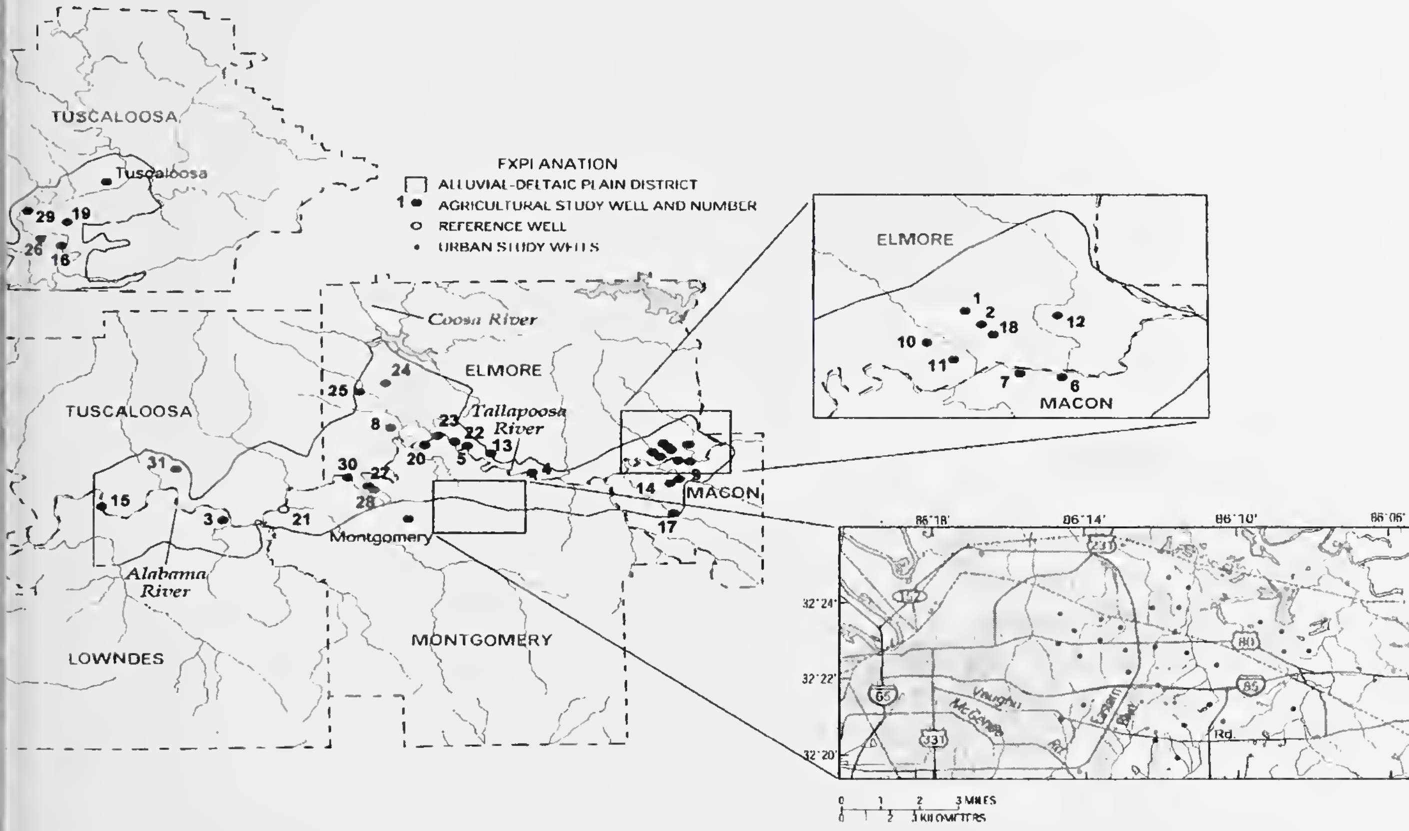
Figure 2. Generalized section of stratigraphic and hydrogeologic units underlying the agricultural study area of central Alabama [after Scott, 1960; Paulson and others, 1962; Knowles and others, 1963; Scott and others, 1987; Gillett and Hunter, 1990; Miller, 1990].

METHODS

Well Network

The USGS installed 30 wells in eastern Montgomery, Alabama, and 29 wells in agricultural areas in central Alabama to enable collection of ground-water samples. One existing well in the agricultural area also was sampled. The wells were installed using threaded, 5-cm diameter polyvinyl-chloride casing with 3-meter-long, 0.002-cm slotted screens. All equipment used to drill the wells was decontaminated with a steam cleaner. The well casings and screens also were cleaned with a steam cleaner and rinsed with de-ionized water prior to installation.

The criteria used to select urban well locations (Fig. 3) are outlined in Squillace and Price (1996). Of primary concern were the criteria specifying that (1) the shallow aquifer in the study area be used as a source of drinking water, a potential source of drinking water, or hydraulically connected to surface water or deeper ground water that is used as a source of drinking water, and (2) land use within the study area be residential and commercial developed between 1970 and the 1990's. The urban study area in eastern Montgomery met these criteria; however, the last criterion was modified to extend the period of residential development in the study area from 1960 to 1998.



ure 3. Location of agricultural and urban wells sampled in the Mobile River Basin, central Alabama
m Robinson, 2003).

The criteria used to select agricultural well locations (Fig. 3) are outlined in Gilliom and others (1995). The two primary considerations for the placement of the wells were that (1) ground water sampled from the wells should be recently recharged (generally less than 10 years old), and (2) the predominant land use in the vicinity of sampled wells be row cropping. This enables direct assessment of relations between land-use activity and ground-water quality (Gilliom and others, 1995). Where urban residential and commercial or row cropping was not the predominant land use surrounding a well, the well was located downgradient from the targeted land-use type.

The urban wells were completed in the alluvial and terrace deposits (14 wells), that overlie and recharge the Cretaceous aquifer system, and in the Eutaw Formation (16 wells). The depth of the urban wells ranged from 5.6 to 29.8 meters with a median depth of 11.9 meters. Ground water from the 30 urban wells was age dated. The ground water ranged in age from 1 to greater than 45 years, with a median age of 12 years. Detailed information about the urban wells used to sample water beneath Montgomery, Alabama, area is documented in Robinson (2002).

The agricultural wells were completed in alluvial and terrace deposits (24 wells) and the Eutaw Formation (6 wells). The depth of the agricultural wells ranged from 6.4 to 17 meters, with a median value of 9.9 meters. A reference well (LUSCR1-21) was installed in the flood plain of the Alabama River (Fig. 3) at approximately the same depth as the wells located in agricultural and urban areas. The reference well was located in a predominately forested area to obtain a sample of ground water that is relatively unaffected by man. Detailed information about the wells used to sample water beneath agricultural areas in central Alabama is documented in Robinson (2003).

Representative samples of the alluvial and terrace deposits and the Eutaw Formation were collected during installation of the urban and agricultural wells. Lithologic descriptions of the sediments were prepared. Sediment cores were collected from each lithologic unit drilled during well installation. Representative sediment samples of each unit were chilled and sent to the USGS NWQL in Denver, Colorado, for organic carbon analysis.

Water-Quality Sampling and Analyses

Sampling procedures followed USGS ground-water sampling protocols (Koterba and others, 1995). Values of pH, temperature, specific conductance, dissolved oxygen, turbidity, and alkalinity were measured during sample collection. Samples were sent to the USGS NWQL in Denver, Colorado, for analysis for 109 pesticides and pesticide degradation products. Samples from 38 wells were analyzed for chlorofluorocarbons (CFCs), dissolved gases, and sulfur hexafluoride (SF_6) at the USGS Chlorofluorocarbon Laboratory in Reston, Virginia. Results of analyses were published in Pearman and others (2001, 2002, 2003) and Robinson (2002, 2003).

The analytical methods and laboratory reporting levels (LRLs) of the National Water Quality Laboratory vary with time. Comparison of detection frequencies between data sets can be misleading because of the different analytical methods and LRLs. Pesticide data are sometimes adjusted by censoring to a common threshold (values less than the threshold are not considered detections) to reduce this type of bias. Analysis for some pesticides in ground-water samples from central Alabama was performed using an analytical method that was capable of detecting much smaller concentrations of pesticides than the analytical method used for the national data set. In comparison to the Alabama data, the national data set may contain “false negatives”. When necessary, pesticide data for central Alabama and the national data set were censored to a common threshold so that detection frequencies could be compared.

RESULTS

The chemical and physical properties of sediments through which ground water lows can affect ground-water quality. Soils with low organic carbon content may increase the potential for pesticides to enter ground water (Barbash and Resek, 1996). Sediment collected from the alluvial and terrace deposits and the Eutaw Formation had organic carbon content ranging from less than 0.01 to 0.33 percent with a median value of 0.03 percent. The low organic carbon content of the aquifer materials may increase the mobility of pesticides in the ground-water system.

Ground water collected from the urban and agricultural wells typically had acidic pH values and low specific conductance and alkalinity values. The values measured were consistent with shallow ground water that ha s been recently recharged (Robinson, 2002). Pesticides were detected in ground water collected from 23 urban and 25 agricultural wells. The most frequently detected pesticides in the urban ground water were atrazine and its degradation products (16 samples), dieldrin (7 samples), and simazine (6 samples). The most frequently detected pesticides in the agricultural ground water were fluometuron (17 samples), atrazine and its degradation products (16 samples), aldicarb degradation products (7 samples), and norflurazon (7 samples). Herbicides and their degradation products were the most frequently detected class of pesticides (Table 2). The greatest concentration of any pesticide was an estimated value of 1.4 microgram per liter (µg/L) of fluometuron.

Ground water collected from 30 urban wells and 8 agricultural wells was analyzed for the environmental tracers CFCs and SF_6. Ground-water age is estimated by relating the measured concentration of the environmental tracer in the ground water to the reconstructed historical atmospheric concentration and (or) to calculated concentrations expected in water in equilibrium with air (Busenberg and Plummer, 1992, 1997, 2000). The estimated age of the water refers to the date of the introduction of chemicals to the water, which is assumed to be from the atmosphere and prior to the water entering the aquifer. Ground water sampled from the urban wells ranged in age from 1 to greater than 45 years with a median value of 12 years. Ground water sampled from the agricultural wells ranged in age from 14 to 34 years, with a median age of 18.5 years. The ages estimated for the ground water are consistent with the geology and hydrology of the study area and the design of the wells.

COMPARISON TO NATIONAL DATA

Pesticide data for central Alabama and the national data set were censored to a common threshold so that detection frequencies could be compared. Censored to a common LRL of $\geq$ 0.01µg/L, ground-water collected from beneath Montgomery, Alabama, had detection frequency rates for dieldrin and deethyl atrazine two to three times greater than the national data set (Table 3). The detection frequency rate for atrazine was about the same as in the national data.

Censored to a common LRL of $\geq$ 0.1µg/L, ground-water collected from beneath agricultural areas in central Alabama had detection frequency rates for fluometuron, norflurazon, and aldicarb sulfone greater than in agricultural areas nationally (Table 3). The herbicide atrazine and its degradation product deethyl atrazine, when censored to a common LRL of $\geq$ 0.01µg/L, were detected less frequently in ground water beneath agricultural areas in central Alabama than in agricultural areas nationally (Table 3).

Table 2. Detection frequencies, maximum concentrations, and application rates for selected pesticides and degradation products in ground water beneath urban and agricultural areas of central Alabama [H, herbicide; I, insecticide; LRL, laboratory reporting limit; µg/L, micrograms per liter; E, estimated concentration less than the laboratory reporting level but above the long-term method detection level or concentration greater than the calibrated range of the apparatus; kg, kilogram; km ^{2}, square kilometer].

Pesticide	**Class**	**Detection Frequency in central Alabama at all LRL (percent)**	**Maximum Concentration (µg/L)**	**[a]Application rate in central Alabama (kg/km ^{2} of county/year)**	**[a]Major Crop**
		URBAN SAMPLES			
Deethyl Atrazine	H	53.3	E 0.36		
Atrazine	H	33.3	.55		
Dieldrin	I	23.3	.05		
Simazine	H	20.0	.28		
		AGRICULTURAL SAMPLES			
Fluometuron	H	58.6	E 1.4	0.2 - 4	cotton
[b]Deethyl Atrazine	H	34.5	E .06		
Atrazine	H	24.1	.15	<.2 - 1	corn
Norflurazon	H	24.1	E .42	.02 - .3	cotton
[c]Aldicarb Sulfoxide	I	24.1	E .06	[d] .1 - 1.4	cotton
[c]Aldicarb Sulfone	I	17.2	E .14		

[a]Application rate of active ingredient; Source: U. S. Geological Survey, 2003.
[b]Degradation product of atrazine; atrazine is applied to corn.
[c]Degradation product of aldicarb; aldicarb is applied to cotton.
[d]Application rate is for aldicarb.

DISCUSSION

Dieldrin was detected in seven samples of ground water collected from beneath Montgomery, Alabama. The insecticide dieldrin was discontinued in 1979, but Verschueren (1983) reported that 75 – 100 percent disappearance of dieldrin from soils can take 3 to 25 years. The age of the ground water containing dieldrin ranged from 2 to 12 years, with a median age of 7 years. This suggests that dieldrin persisting in soil is transported into the shallow aquifer beneath Montgomery, Alabama by rainwater or watering of lawns.The frequency of detection of fluometuron, norflurazon, and aldicarb sulfone in central Alabama agricultural areas (Table 3) is consistent with their application rates in central Alabama, which rank in the middle to upper third of application rates nationally(U.S.Geological Survey, 2003).

Table 3. Detection frequencies at common laboratory reporting levels for selected pesticides in ground water beneath agricultural areas of central Alabama and the Nation [µg/L, micrograms per liter; GC/MS, Gas Chromatograph/Mass Spectrometer, NWQL schedules 2001 and 2010; HPLC, High Pressure Liquid Chromatograph, NWQL schedules 2050, 2051, 2060].

Pesticide	Detection Frequency Alabama (percent)	[a]Nation (percent)	Common LRL (µg/L)	Analytical method	National Rank of Alabama application rate
URBAN SAMPLES					
Atrazine	16.7	17.9	≥ 0.01	GCMS	
Deethyl Atrazine	30.0	13.7	≥ 0.01	GCMS	
Dieldrin	10.0	3.04	≥ 0.01	GCMS	
Simazine	16.7	≥ 11.9	≥ 0.01	GCMS	
AGRICULTURAL SAMPLES					
Fluometuron	20.7	0.24	≥ 0.1	HPLC	mid - upper thi
Norflurazon	6.9	1.96	≥ 0.1	HPLC	upper third
Aldicarb Sulfone	3.4	≥ .08	≥ 0.1	HPLC	[b]mid - upper thi
Atrazine	17.2	29.0	≥ 0.01	GC/MS	lower third
Deethyl Atrazine	6.9	26.7	≥ 0.01	GC/MS	

[a] Source U. S. Geological Survey, 2003.

[b] Application rate is for parent product, aldicarb.

The frequency of detection of atrazine and deethyl atrazine (Table 3) is consistent with the application rate of atrazine in central Alabama, which ranks in the lower third of application rates nationally (U.S. Geological Survey, 2003).

Nationally, in both urban and agricultural land use settings, atrazine and deethyl atrazine typically are detected at about the same frequency over a range of concentrations from 0.1 to greater than 1.0 µg/L (Table 4). A graph of the detection frequencies of atrazine and deethyl atrazine in the national data set, grouped into four concentration levels (all detections, ≥0.01, ≥0.1, and ≥1.0), shows a linear trend for both urban and agricultural land-use settings (Fig. 4). Results of linear regression analysis (Fig. 4) indicates that detection frequencies of atrazine and deethyl atrazine are directly related.

Atrazine was detected less frequently than deethyl atrazine in the central Alabama urban ground water. A graph of detection frequencies of atrazine and deethyl atrazine in the central Alabama urban ground water, grouped into four concentration levels (all detections, ≥0.01, ≥0.1, and ≥1.0), shows a linear trend; however, the data plot above the national data

Table 4. Detection frequency at common laboratory reporting levels for atrazine and deethyl atrazine in ground water beneath agricultural and urban areas of central Alabama and the Nation [µg/L, micrograms per liter].

		Detection Frequency (percent) at Common LRL (µg/L)			
	Pesticide	**All**	**≥ 0.01**	**≥ 0.1**	**≥ 1.0**
		[a]NATIONAL DATA			
Urban	Atrazine	32.0	17.9	5.28	0.72
	Deethyl Atrazine	31.5	13.7	2.52	0.00
Agricultural	Atrazine	41.9	29.0	13.6	1.53
	Deethyl Atrazine	42.0	26.7	10.9	0.63
		CENTRAL ALABAMA DATA			
Urban	Atrazine	33.3	16.7	10.0	0.0
	Deethyl Atrazine	53.3	30.0	16.7	0.0
Agricultural	Atrazine	24.1	17.2	3.4	0.0
	Deethyl Atrazine	34.5	6.9	0.0	0.0

[a] Source U.S. Geological Survey, 2003.

(Fig. 4). Results of linear regression analysis indicates that detection frequencies of atrazine and deethyl atrazine are directly related; but deethyl atrazine was more frequently detected in the Alabama urban land-use setting than in the national urban data set.

In the central Alabama agricultural data, a graph of the detection frequencies of atrazine and deethyl atrazine, grouped into four concentration levels (all detections, ≥0.01, ≥0.1, and ≥1.0), shows that the data plot is not linear (Fig. 4). This suggests that the occurrence of deethyl atrazine in the Alabama agricultural area is not directly related to the occurrence of atrazine. The detection frequencies of atrazine and deethyl atrazine in the central Alabama agricultural data may indicate that atrazine is not the only parent compound that is degrading to produce deethyl atrazine. Deethyl atrazine also can be a by-product of propazine degradation (Thurman and others, 1998). Cyprazine also degrades into decyclopropyl cyprazine, which is structurally identical to deethyl atrazine (Barbash and Resek, 1996). Use of cyprazine, sold under the trade name of Outfox, was discontinued in 1989. The Alabama Department of Environmental Regulation (Dr. Enid Probst, oral commun., 2003), Alabama Department of Agriculture and Industry (Tony Cofur, oral commun., 2003), and the Alabama Cooperative Extension Service (Dr. John Everest, written commun., 2003) have no record of cyprazine ever being used in Alabama. Propazine, sold under the trade name of Milogard, was applied to sorghum in central Alabama for several years, but its use is no longer recommended (Dr. John Everest, Alabama Cooperative Extension Service, written commun., 2003). Ground-water samples collected for this study were not analyzed for propazine; however, it is possible that some of the deethyl atrazine detected in the ground water resulted from propazine degradation.

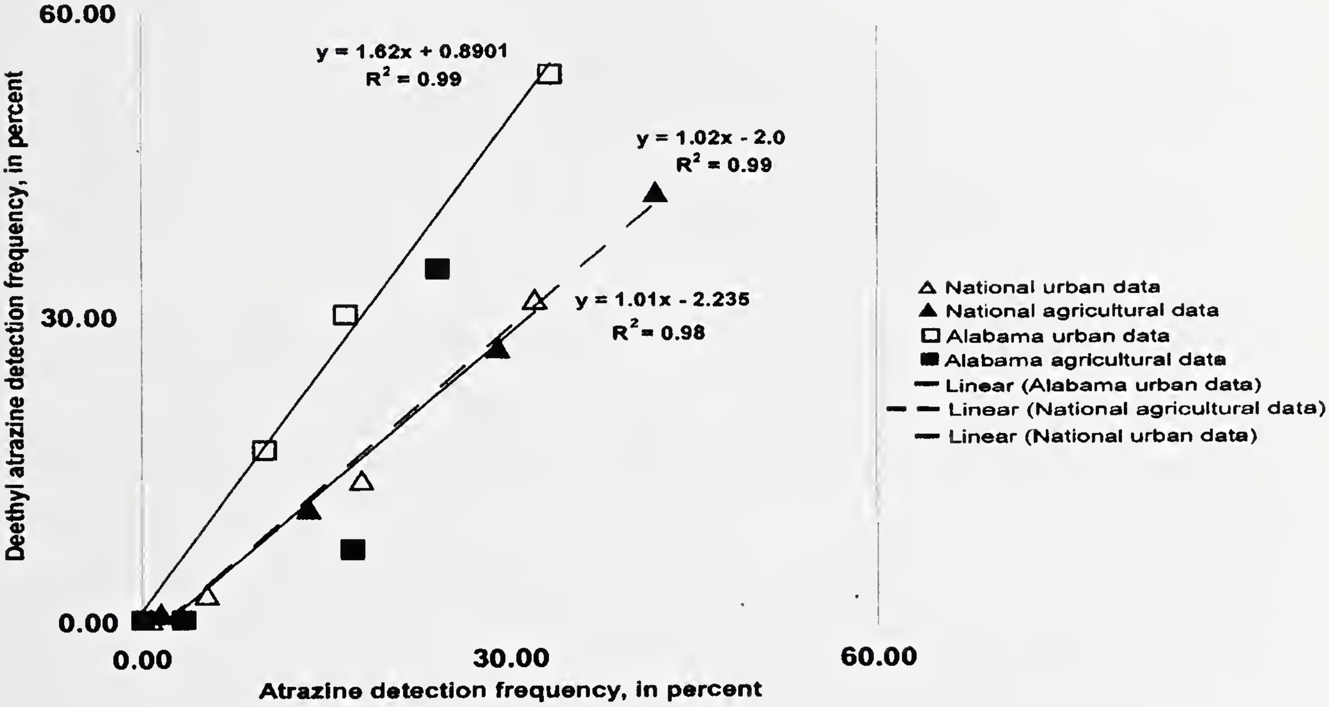


Figure 4. Atrazine and deethyl atrazine detection frequencies for national and central Alabama data sets for the four data groupings listed in Table 4; all detections; ≥0.01; ≥0.1; ≥1 ug/L.

SUMMARY AND CONCLUSION

The urban and agricultural study areas in central Alabama are located in the flood plains of the Alabama, Black Warrior, Coosa, and Tallapoosa Rivers. The flood plains are underlain by alluvial and terrace deposits and the Cretaceous aquifer system. These sediments have a low organic carbon content, which may increase the mobility of pesticides in ground water.

Pesticides were detected in 23 of 30 urban ground-water samples and 25 of 29 agricultural ground-water samples. The most frequently detected compounds in the urban land-use setting were deethly atrazine, atrazine, dieldrin, and simazine. The most frequently detected compounds in the agricultural land-use setting were fluometuron, deethyl atrazine, norflurazon, atrazine, aldicarb sulfoxide, aldicarb sulfone, diuron, and metolachlor. The frequency of detection of these pesticide compounds in central Alabama, when compared to their frequency of detection nationally, is consistent with their application rates in central Alabama. Detection frequencies of atrazine and deethyl atrazine in ground-water collected from central Alabama may indicate that an additional parent compound such as propazine also is degrading to produce deethyl atrazine; however, ground-water samples collected from central Alabama were not analyzed for propazine.

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Sprague, Alan P.
Srinivas, Raghavan N.
Sudarsan, Rajesh
Sun, Changlin
Tao, Tao

Thomas, Robert E.
Velusamy,Vijay
Walters, J.V.
Wang, Yibing
Wisniewski, Raymond B.
Wong, Daisy
Wu, Xiaqing
Xu, Chuang
Xu, Chuanixi
York, Gary
Zhang Jing
Zhang, Mila
Zhao, Wei
Zheng, Xidong
Zhou, Song

SECTION XI
ANTHROPOLOGY

Cole, Brigitte
Driskell, Boyce N.
Gage, Matthew D.
Henson, B. Bart
Holstein, Harry O.
Hurley, Molly
Koerper, Phillip E.
Mann, Jason A.
Ridley, Rebecca
Rowe, Bobby
Runquist, Jeanette
Sherard, Jeffrey L.
Speegle, Heath F.
Twe, Kyla Elizabeth

Journal of the Alabama Academy of Science, Vol. 74, Nos. 3/4, July/October, 2003.

Minutes
AAS Fall Executive Committee Meeting
Main Lecture Room – Chemistry Building
University of Alabama at Birmingham
Birmingham, AL 35294
October 18, 2003

Call to Order and Approval of Minutes (A) President Anne Cusic called the meeting to order at 10:07am, and the Executive Committee approved the minutes from the March 19, 2003 meeting at Jacksonville State University.

Officer Reports (B)

1. Eugene Omasta (**Board of Trustees**) had no written report, but did introduce the new Board members

2. Anne Cusic (**President**) reported the following activities as part of the duties of the office:
   - The majority of my time was spent filling vacancies on the various committees. This not only involved contacting individuals, but also making sure that the appointment times conformed with those stated in the Constitution of the Academy;
   - I also spent time updating email addresses for the officers, trustees, and committee members;
   - I attended the site visit to the University of Montevallo;
   - I have been in touch with Houston Byrd and Kay Watts at Montevallo concerning planning for the March 2004 meeting;
   - I helped resolve a problem with a student research award in the Health Science Section brought to my attention by Peggy Hayes;
   - I consulted with Mike Moeller concerning an issue with the Mason Scholarship;
   - I worked with Dan Holliman and Larry Krannich to arrange the fall executive dinner and meeting;
   - I have been in contact with Richard Hudiburg in updating the website for this year's officers, committees, and annual meeting information;
   - I have worked with Larry Krannich on several issues concerning the Academy;
   - I have been in contact with Donald Salter and Mark Meade concerning revenues for the Academy from the last two annual meetings

3. Ron Jenkins (**President-Elect**) – report not submitted or misplaced

4. Larry Davenport (**Second Vice-President**) had no written report, but did attend the site visit at the University of Montevallo

5. The **Secretary** (Dail Mullins) – I report the following activities as part of the duties of the Secretary:
   - Transferred all checks/cash received for dues to the Treasurer after recording information on the master roll (kept by Kathryn Pitt – kpitt@uab.edu);
   - Attended pre-conference planning site visit to the University of Montevallo;
   - Provided the editor of the *JAAS* with membership rolls and mailing labels as requested;
   - Made requested mailing address and/or email address changes to the master roll upon receipt of information from individual members;
   - Provided membership rolls/lists to Section Heads as requested by them or the Executive Officer;
   - Submitted minutes of the fall AAS Executive Committee meeting (October, 2002) to the editor of the *JAAS* and AAS webmaster as requested;
   - Provided the former president (Stephen Watts) with copies of the National Academy of Sciences publication, "Teaching About Evolution and the Nature of Science" for a home-schooling group which contacted the Academy for guidance in the area of the biology curriculum.
   - Set up an email distribution list of all members with registered email addresses for the purpose of sending out the dues notification cards. Members for whom we do not have an email address will have to be contacted by regular mail. This first email notification was sent out on 10/16/03.

   It was also agreed that, following distribution of the above by email, we would follow up with surface mail for people we did not hear from.

   As mentioned in last year's report, I will be retiring from UAB and moving out-of-state effective July 1, 2004, and so will not be able to serve a full second term. I can agree to remain on as secretary through April or May of next year, but the Executive Committee needs to begin a search for my replacement as soon as possible.

6. Betsy Dobbins (**Treasurer**) submitted the following report: The current annual income for the Academy is $26,823.28. To date, expenses have exceeded income by $1,410.61, which is less than in previous years ($3,993 for 2002, and $2,286 for 2001). Total income to date is equivalent to last year. There has been a slight increase in interest income from last year due to the timing of interest payments and a slight increase in Journal income. Interest income was less than budgeted due to the general decrease in interest rates. Dues income remains at the 2002 level. There is outstanding income due from the Annual meeting from 2003 and 2002, and from

ISEF expenses that should enable us to balance income and expenses by the end of the year.

The expenses to date are $2,000 less than in 2002. This difference is primarily due to $3,200 less in Journal expenses and $1,000 less in Gorgas expenses. Unlike 2002, we awarded a Mason Scholarship ($1,000) and gave $1,600 to the Junior Academy for 2003.

A copy of the proposed budget for 2004 is also attached (to this report). The budget has been altered to reflect interest payment realities and the increased income from the Journal. The budgeted income for dues has been raised to $9,000. The 2002 dues income was $9,900 and the 2001 income was $11,200. In both cases, $3,550 to $4,500 were remitted in the fourth quarter. If this trend continues, we will collect $9,000 in dues for this year and can project the same for next year. Expenses have been altered slightly to reflect a pattern of awards and expenses, with a large decrease in printing expenses for the Journal and an added category for mailing. There have also been categories added for bank charges and website management. The flow-through expenses for ISEF have been increased to reflect the Oregon location.

After presenting her report, the Treasurer pointed out that the first line is now incorrect, since the Academy has received a check from Jacksonville State Univeristy. Mark Meade reported on a form he brought summarizing the finances associated with the Jacksonville State University meeting.

Eugene Omasta (**Board of Trustees**) interjected at this point, requesting that the Executive Committee approve accepting the budget (item C2). The budget was accepted.

7. The **Editor of the *JAAS*** (Jim Bradley) submitted the following report: Publication of the *JAAS* is behind schedule, due primarily to my being on professional improvement leave from Auburn University since last June. The January and joint April/July issues are assembled and should be going to the printers before the holidays. The October issue will be assembled in time for the Carmichael Committee to make its selection of the best paper for 2003 sometime in early February.

   The Auburn University Library continues to subsidize publication of the journal. Currently there are $2,656 in that account, and $4,791 additional will be added to the account for FY 2003-04. (Note: the Auburn Library does receive some benefit from mailing the journal, since they get other journals free on exchange)

   The Journal is now published by Davis Printing, Montgomery, AL

I do not desire to continue as editor of the journal past my current term. If someone wishes to assume the editorship prior to the end of my current term, I would be amenable to that.

Jim Bradley also reported on the status of the proposed new Academy Section (XII, Bioethics & History and Philosophy of Science). His report was as follows: At the Spring Executive Committee meeting of the Academy, 2003, I proposed adding this section to the Academy and volunteered to be its first chairperson. After some discussion, the Committee agreed that this is a good idea if enough people would support it by contributing papers. The president asked that I determine interest in the new section and that if 10-15 persons showed interest, that I should report this at the fall Executive Committee meeting and receive its approval for establishing this section in time for the spring meeting, 2004. I am happy to report that 26 persons at AU, UAB, and Tuskegee University have expressed interest in this section. I therefore request that the Executive Committee approve the new section and that its debut be at the March, 2004 meeting of the Academy. This request was discussed and approved.

8. The **Counselor to AJAS** (B. J. Bateman) – 2003 Annual Report of the Alabama Junior Academy of Science and the Junior Science and Humanities Symposium

State Officers/Counselors Meeting – the State Officers and the State Counselors met at the University of West Alabama to discuss the State Officer's roles for the upcoming year (2002-03)

Fall AAS Executive Meeting – the State Counselor to AJAS attended the Fall Executive meeting of the Senior Academy held at the Southern Research Center. A report was given concerning the forthcoming annual meeting to be held at Jacksonville State University.

Annual Meeting – the 2003 Annual Meeting, like all previous meetings of AJAS, was shared jointly with the AAS. The host institution was the University of West Alabama. Mark Meade, local arrangements for the AJAS, B. J. Bateman, Counselor to the AJAS, and Wanda Phillips, Associate Counselor, planned registration procedures, space needs, and arrangements for the AJAS-JSHS social and banquet. Registration was held at the University Inn in Jacksonville, AL

Highlights of the program were:

- Paper Competition – conducted on Friday morning in the Houston Cole Library and Saturday morning in the Theron Montgomery Auditorium on the Jacksonville State University campus. Michael Vincent was chosen the overall winner and will therefore represent Alabama in national competition helt at Colorado Springs, CO, April 30-May 4. Of the other four state winners (Elijah Riddle, Auroop Roy, Jennifer Taylor, and Michael Taylor) only Elijah, Jennifer, Michael, and B. J. Bateman would accompany Michael to Colorado

- Banquet – more than 100 students, teachers, university professors, and members of business, industry and government shared the Friday night banquet at the Auburn University Conference Center. A major part of the after-dinner program was the recognition of the first- and second-place winners of the paper competition, and other competitions. On alternate years the Junior Academy is responsible for the banquet speaker. This year's speaker, Dr. Bruce Braughn, Director of the Office of National Preparedness, spoke on national preparedness.
- AJAS-JSHS Social Activities – the Theron Montgomery auditorium was available for the time after the banquet for a dance
- Business Meeting – the customary AJAS Business Meeting was held on Saturday morning. This provided a time for awarding a plaque to the outstanding region, a certificate and a check to the outstanding teacher(s), and other awards.

9. **Science Fair Coordinator** (Virginia Valardi) – sent a letter to the meeting with President Anne Cusic

10. The **Science Olympiad Coordinator** (Jane Nall) submitted a written report which was a copy of the new Science Olympiad website (http://aso.jsu.edu)

11. Steven Watts (**Counselor to AAAS**) submitted the following report: All state Academies generally maintain an association with the American Association for the Advancement of Science. We are members of the Section on Agriculture, Food and Renewable Resources. There are several other committees that are currently being re-organized in response to the changing scientific environment and the AAS may have an opportunity to have direct input on these committees. These changes are currently in discussion.

12. **Section Officers** – written reports were submitted for Section I (Biological Sciences) and Section VIII (Behavioral and Social Sciences)
    - Section I – I report the following activities as part of the duties of the Chair: I have contacted Biology Departments throughout the state to encourage participation in the Academy and the annual meetings
    - Section VIII – this section met at the Annual Meeting on Friday, March 21, 2002, at Jacksonville State University. We had a total of 17 papers scheduled for presentation. 12 of the 17 were presented. The business meeting consisted of a discussion about the progress of the annual meeting, ways to increase visibility of the Academy and to increase the number of pre-

senters at the Annual Meeting. Terms for both the Chair (Janice Wittekind) and Vice Chair (Arthur Wilke) have expired. Betsy Witt from Columbus State University is the new Chair. The position of Vice Chair is vacant.

13. Larry Krannich (**Executive Director**) submitted a written report of activities since the Spring meeting: Since March, 2003, I have been involved in the following activities associated with the Executive Director of the Alabama Academy of Science position:
    - Revised and developed a membership recruitment flier that is being distributed to all section chairs (Dr. Krannich underscored the need to recruit new members into the Academy)
    - Revised and developed the Call for Papers flier for the 81st Annual Meeting of the Academy
    - Participated in the July 16th site visit for the 81st Annual Meeting of the Academy at the University of Montevallo
    - Mailing letters to universities for Journal of the Alabama Academy of Science support
    - Working with the Section Chairs to develop a membership recruitment initiative
    - Meeting with the Gorgas Scholarship Committee

    Dr. Krannich also discussed deadlines for the Academy's Research (Feb 6) and Travel (Jan 16) grants.

Committee Reports (C)

- **Local Arrangements** (Houston Byrd) – Dr. Byrd submitted a written summary of preparations underway for the 81st Annual Meeting at the University of Montevallo

- **Finance** (Eugene Omasta)—.The Alabama Academy of Science continues to be in excellent financial condition with total assets of $72,197. The assets for the past four and three-quarter years as reported at the Fall Executive Committee meetings and Annual Spring meetings of the Academy are as follows:

	Assets	**Change**		**Assets**	**Change**
1/1-10/1999	**$76,219**		**1/1-12/31/1999**	**$85,330**	
1/1-10/16/2000	**$72,814**	**-$3,405**	**1/1-12/31/2000**	**$74,059**	**-$11,281**
1/1-10/12/2001	**$71,763**	**-$1,051**	**1/1-12/31/2001**	**$75,813**	**$1,764**
1/1-10/12/2002	**$72,197**	**$434**	**1/1-12/31/2002**	**$72,813**	**-$3,000**
1/1-10/12/2002	**$71,403**	**-$794**			

The dues increase of $5 annually and the reduction of the number of Journal issues from 4 to 3 by combining the abstract issue with one of those three issues should have a significant impact this year on the Academy's assets.

Essentially the Treasurer's proposed budget for 2004 has slight changes over the 2003 budget. The income is projected to increase by $2,885. This results from expected increases in dues and Journal income. The increased income coupled with an expected decrease in Journal expenses and other moderate increases and decreases results in a projected deficit of $4,150. ISEF expenses/income should be ignored since this is flow-through money. I recommend acceptance of the proposed 2004 budget (approved).

- **Membership** (Mark Meade)— I report the following activities as part of the duties of the Chair: BBB students at Jacksonville State University have been contacting and updating our membership list. Currently they have contacted nearly 100 members and updated some addresses

- **Research** (Steve Watts)—This past spring, Larry Boots stepped down as chair of the Research Committee, citing probable future time commitments. We appreciate his contribution to the Academy as Chair of the Research Committee (left vacant by the previous chair) I have volunteered to take on the role of Chair for the next cycle. Most of the members of the committee are new and include Larry Boots, Bruce Smith, Robert Thacker, and Alan Sprague. I will be coordinating research committee activities with Anne Cusic, Larry Boots and Larry Krannich as we prepare for the 2004 meeting. One change we hope to add is the electronic submission of all materials for the paper and poster competition and the research grant competition. This will allow for easy dissemination to the committee for evaluation and timely completion of all tasks. A second email record of all students applying for student poster/paper awards will be held by the webmaster, Richard Hudiburg, as a backup. We will completely eliminate a hard-paper trail this year. All information on the competitions will be updated on the web site.

- **Long-Range Planning** (Ken Marion)—there was no formal report.

- **Auditing-Senior Academy** (David Schedler)—no report

- **Auditing-Junior Academy** (Govind Menon)— I have examined the books provided by the Alabama Junior Academy of Science Treasurer, Dr. B. J. Bateman, and was satisfied that he receipts and expenditures, as presented, are correct and that all expenditures are legitimate expenses. The net worth as of 6/30/2003 is $24,432.43.

- **Editorial Board and Associate Journal Editors** (Thane Wibbels)—no report.

- **Place and Date of Meeting** (Thomas Bilbo) – no report. Larry Krannich announced that the 82nd Annual Meeting was to be at Troy State Dothan, but that that is now in question. If not, it will be held at Birmingham Southern College

- **Newsletter/Electronic Media** (Chair position open)—no report. It was decided that we would drop the newsletter.

- **Public Relations** (Richard Buckner)—no report

- **Archives** (Troy Best)—Troy Best, who could not attend the meeting, sent a letter/report along with Anne Cusic. We will need to obtain photographs (especially of members of the Executive Committee), committee reports, minutes of the AAS Executive Committee meetings, etc. If you have items you believe are worthy of inclusion in the AAS Archives, please send them to me, or directly to Dr. Dwayne Cox, the archivist in charge of AAS materials at the Auburn University Ralph B. Draughon Library. I encourage all members and officers to donate significant documents, photographs, etc., to the archives.

- **Science and Public Policy** (Dail Mullins)—no report

- **Gardner Award** (Prakash Sharma)— The committee would like to request that each and every member of this academy publicize to individuals, deans, and provosts of colleges and universities, information about this award. Please solicit nominations from individuals and different academic and industrial organizations for this award. The nominations should be forwarded to P. C. Sharma, Chair, Wright Gardner Award Committee, Head of Physics Department, Tuskegee University, Tuskegee, AL 36088. Phone 334-727-8998. email: pcsharma@tusk.edu. Nominations should consist of the following documents:
    - Formal nomination letter
    - Vitae and at least two letters of reference from peers, administrators or experts in area of research
    - One page citation that will be used for presentation of award

  The closing date for nominations is November 30, 2002. The award will be presented at the Annual Meeting of the Academy in March, 2004

- **Carmichael Award** (Velma Richardson)— The following report was submitted: The article selected for the E. B. Carmichael Award this year is "In Vitro External Factors Influencing Tight Junctions and the Accuracy of Transepithelial Electrical Resistance Measurement," by John G. Eley, Department of Pharmacal Sciences, Harrison School of Pharmacy, Auburn University, AL. This article appears in the January, 2002 issue of the *Journal of the Alabama Academy of Science* 73(01):21-29. All papers appearing in Volume 73 were included in the judging.

- **Resolutions** (Priscilla Holland)—no report (although Dr. Cusic will send recommendations of Drs. Berte and Holliman to Dr. Holland)

- **Nominating Committee** (Ron Jenkins)—no report

- **Mason Scholarship** (Michael Moeller)— Last year we had two completed applications for the William H. Mason Scholarship. After reviewing all application materials, the scholarship committee voted to offer the $1,000 award to Kanessa N. Miller and she accepted.

The previous recipients of the William H. Mason Scholarship are:

1990-91	Amy Livengood Sumner
1991-92	Leella Shook Holt
1992-93	Joni Justice Shankles
1993-94	Jeffrey Baumbach
1994 -95	(Not awarded)
1995-96	Laura W. Cochran
1996-97	Tina Anne Beams
1997-98	Carole Collins Clegg
1998-99	Cynthia Ann Phillips
1999-2000	Ruth Borden
2000-2001	Karen Celestine Amy Murphy
2001-2002	Jeannine Ott
2002-2003	(Not Awarded)
2003-2004	Kanessa Miller

Attached to this report is a copy of an announcement that the committee plans to be sending soon to deans in schools of science and education within Alabama. Members of the AAS Executive Committee are encouraged to copy and disseminate this information.

- **Gorgas Scholarship Program** (Ellen Buckner)—The Gorgas Scholarship committee met on October 18, 2003. We reaffirmed to waiver the instate rules so that any winner may receive Gorgas Awards. This has proved significant to increasing the caliber of the competition. A list of winners from 2003 competition is attached. The assets of the fund have stabilized and are again increasing. The committee thanks Mr. Art Beattie and the Alabama Power Foundation for managing the fund and supporting it during the period of low economic growth.

- **Electronic Media** (Richard Hudiburg)— I report the following activities: (1) Responded to various requests from the President and other members concerning changes to the AAS website. I posted the updated information for Alabama Academy of Science officers, committees, and section officers for 2003-2004; (2) Currently developing on-line paper and poster title submission forms for each section of the AAS for the 81st annual meeting. The forms will be located on the Academy website. The website will have on-line submission forms for the Committee on Research paper and poster competition and travel; (3) Renewed web hosting support (one year - $93.24) and domain name (two years - $30) for the Academy website through PowWeb hosting; (4) Posted information for the 2003-04 Gorgas Scholarship Competition on the Academy website; (5) I will update information and add links for the 81st annual meeting at the University of Montevallo on the Academy website; (6) POP3 email addresses (up to 100) are available to AAS officers through the Academy website. If you wish an email account, email me at the following address: rhudiburg@alabamaacademyofscience.org

It was moved, and seconded, that all reports be accepted. Passed unanimously.

Old Business (D)—There were 3 matters of Old Business brought to the attention of the Executive Committee: (a) the makeup of the Constitution Revision Committee; (b) the Endowment Committee; and (c) Dr. Sharma's discussion of Fellow status in the Academy. After some discussion, it was decided that the Constitution Revision Committee would include Steve Watts, Larry Krannich and Larry Davenport. The discussion of Fellow status was postponed until the Spring meeting.

New Business (E)—Two items of new business were brought to the attention of the Executive Committee: (a) the fact that this secretary would be retiring on July 1, 2004, and that a replacement needed to be found soon; and (b) the fact that in the past, and perhaps now, there are folks active in AAS who are not up to date on their dues.

Adjournment (F)—the meeting was adjourned at 12:28pm

Respectfully submitted,

Dail W. Mullins, Jr.
Secretary

INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. A. Priscilla Holland, Office of Research, UNA Box 5121, University of North Alabama, Florence, AL 35632-0001. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology: Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics, Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the implies that it has not been published previously and that it not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

Submission: Submit an original and two copies to the editor. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. The editor may request that manuscripts be submitted on a diskette upon their revision or acceptance.

Manuscripts: Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. An abstract not exceeding 200 words will be published if the author so desires. Use heading and subdivisions where necessary for clarity. Common headings are: **Introduction** (including literature review), **Procedures** (or **Materials and Methods**), **Results, Discussion,** and **Literature Cited.** Other formats may be more appropriate for certain subject matter areas. Headings should be in all caps and centered on the typed page; sub-headings should be italicized (underlined) and placed at the margin. Avoid excessive use of footnotes. No not use the number 1 for footnotes; begin with 2. Skip additional footnote numbers if one or more authors must have their present address footnoted.

Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must not exceed 15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in the text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

Tables: Place each table on a separate sheet. Place a table title directly above each table. Number tables consecutively. Use symbols or letters, not numerals, for table footnotes. Cite all tables in the text.

Literature Cited: Only references cited in the text should be listed under **Literature Cited.** Do not group references according to source (books, periodicals, newspapers, etc.). List in alphabetical order of senior author names. Cite references in the text parenthetically by author-date.

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